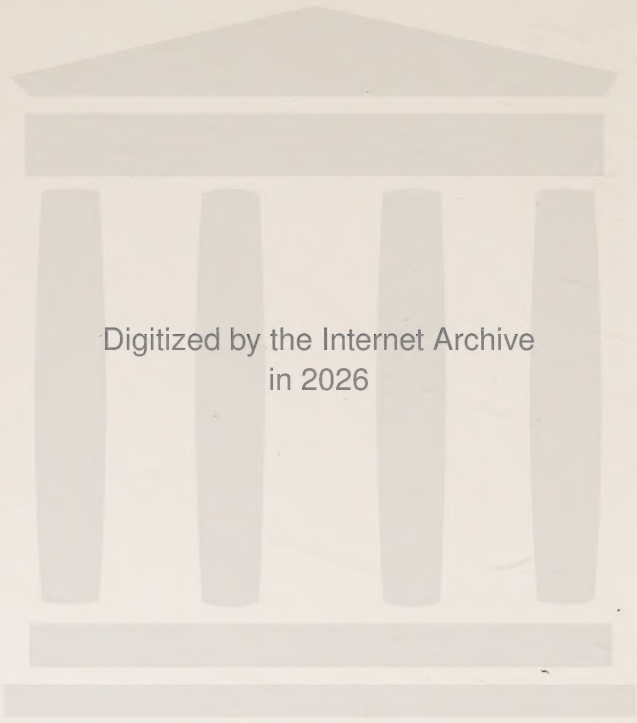


ARTIFICIAL WATERWAYS
OF THE WORLD

A. BARTON HEPBURN



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THE WORLD

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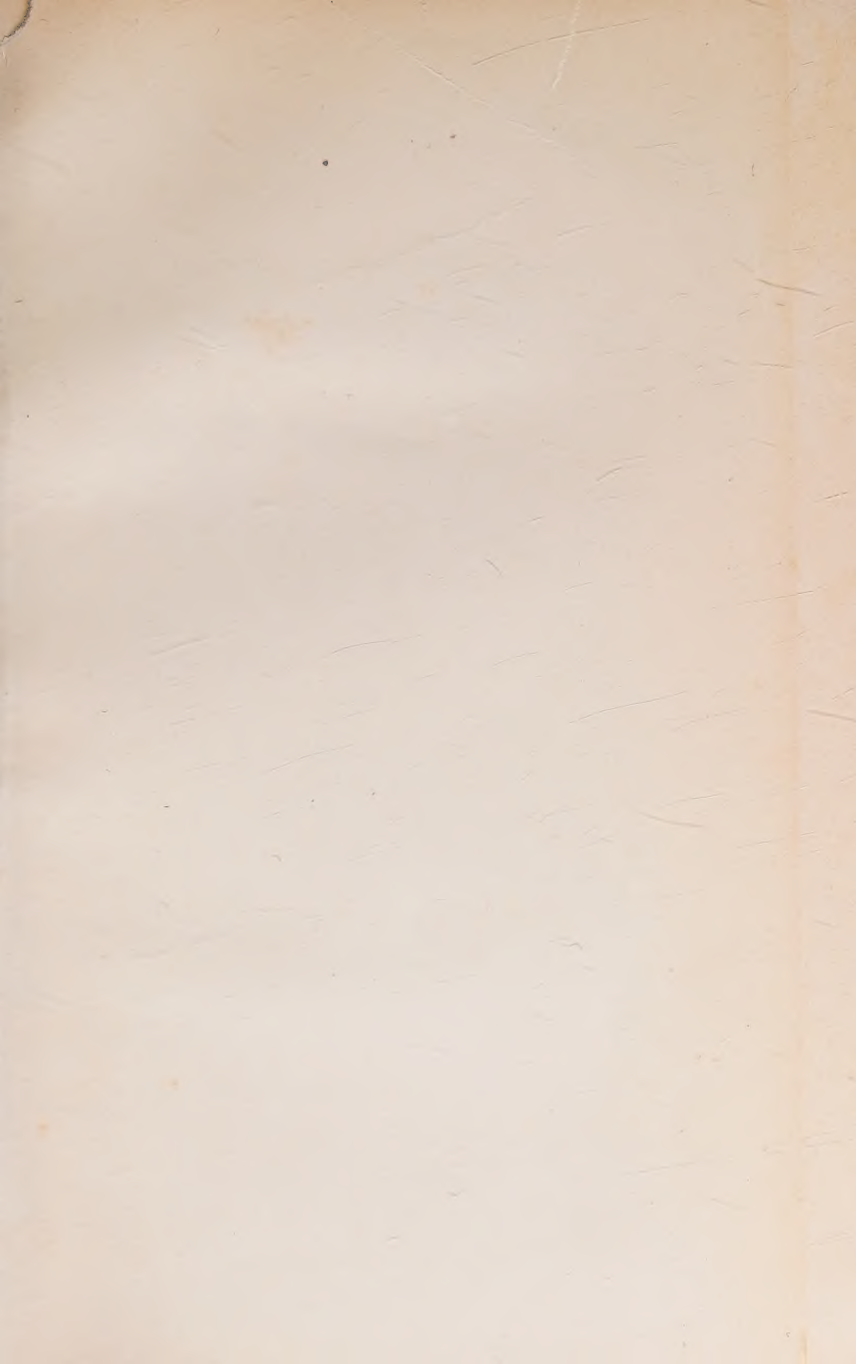
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GOV. CLINTON AND PARTY ON "SENECA CHIEF" ENTERING CANAL AT BUFFALO.
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ARTIFICIAL WATERWAYS OF THE WORLD

BY

A. BARTON HEPBURN

AUTHOR OF "HISTORY OF COINAGE AND CURRENCY"

New York

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1914

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Set up and electrotyped. Published January, 1909.

New Revised and Enlarged Edition, November, 1914.

FOREWORD

THE first improvement upon the slow, tedious and costly means of transportation by beasts of burden and vehicles was accomplished by utilizing rivers, supplemented by canals, as a thoroughfare for boats and barges.

These waterways determined the routes of commerce until the locomotive engine made land routes the more popular, as they were the more expeditious. Reaching in all directions, spanning waterways, tunneling mountains, and defying obstacles generally, they naturally took command of trade. In almost all other countries, the commercial advantage of maintaining both land and water routes was fully appreciated; in the United States, the impatience of all delay, which characterizes our people in the rush to anticipate the future and bring the latent resources of our phenomenally rich country into soonest possible use, however wasteful such haste may be, found expression in the development and expansion of railway, and the com-

parative neglect of canal and river transportation, especially during the last three decades. Denser population with increased local needs, the greater consumption which accompanies the growing wealth of the people, the congestion of traffic generally, and many other causes, are teaching people the unwisdom of neglecting the cheaper, albeit slower, means of transportation.

People have come to realize that the function of artificial water navigation is to supplement and complement, and not to rival the railways. The great development and successful rivalry of the Canadian canals have attracted wide attention and done much to bring to our people a proper appreciation of the great service which canals and canalized rivers may render.

The failure of New York to develop and maintain her canal system found yearly expression in the loss of commerce to the city of New York; this manifest fact led to the present great work of enlarging the capacity of her canals. Her canal system is typical, and influences which call for improvement and enlargement in New York will, with equal force, call for the development of artificial waterways throughout the

country. Such development seems to be an imperative need of internal trade.

In order to place before the public in concise form the salient facts as to artificial waterways and their relation to commercial development, this volume was prepared and is now submitted in revised form. It presents, in some degree, the history of canal systems of all countries and the present status of such systems, as set forth in the latest obtainable official reports. It aims to present to the reader, in lucid and concise form, frequently the form of statistics, the present condition of the canals and canalized rivers of the world.

I am greatly indebted to Sereno S. Pratt, the able and accomplished Secretary of the New York Chamber of Commerce, by whom the tables made use of were largely prepared. All of the statistics have been verified by him.

A. BARTON HEPBURN

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ARTIFICIAL WATERWAYS OF
THE WORLD

ARTIFICIAL WATERWAYS OF THE WORLD

THE WORLD'S CANALS

THE importance of a well-devised and judiciously located canal system, as a factor in the material development and substantial progress of a country, is apt to be under-estimated by most men, in these days of multiplied railway communication. Prior to the first quarter of the nineteenth century, mankind was dependent upon the tedious and costly transportation by animal power, except where waterways could be made available. Adam Smith, writing of course before the era of railways, and having observed the enormous difficulties of traffic over poor highways, in imperfect vehicles, characterized the introduction of artificial waterways very conservatively when he said, in his "Wealth of Nations," that "navigable canals are among the greatest of all improvements."

We find the canal device for supplementing

Nature's gifts to man in the way of inland seas and rivers, utilized very early in the history of the race; for even if we regard as perhaps legendary the assertion of Egyptologists that the predecessors of the Pharaohs had created a canal system as far back as 7000 B. C., it is quite certain that the Egyptians, the Chaldeans, and probably also the Chinese, dug artificial waterways many centuries before the beginning of the Christian era. At first these man-made waterways were, doubtless, merely for irrigation purposes; but it was not long before they were utilized to transport surplus products from place to place, connecting natural bodies of water; eventually circumventing the obstacles presented by cataracts; ultimately shortening ocean routes for the largest vessels, like the Suez and Panama canals, and converting inland cities into artificial seaports, as in the case of Manchester, England.

Constructive ingenuity must have been developed quite extensively to have made it possible for Nebuchadnezzar to restore the great canal of Babylon, mentioned by Herodotus as one of that ancient city's wonders; originally cut, as the antiquaries state, about 1700 B. C., that

great ruler made it available for merchant vessels in his day (say 600 B. C.). It would appear that at about this time also there was begun the construction of the predecessor of the present Suez Canal, connecting the Nile with the Red Sea, finished later by one of the rulers of Egypt. This waterway is said to have been in use until the ascendancy of the Mohammedans in Egypt; the caliph Al-Mansour ordered its destruction A. D. 767 and his name is likely to live in history on account of this discreditable act, rather than any good which he accomplished.

It is a noteworthy fact that those great road and aqueduct builders, the Romans, have left us no important commercial waterways. Marius indeed connected the Rhone with the Mediterranean in Gaul, and Claudius joined the Tiber and the sea; in Britain two dikes are credited to the Roman period; but of these relatively insignificant examples nothing remains at this day; the records show a number of ambitious plans for canals during the reign of the Cæsars, but their wars rendered the practical execution of these enterprises impossible. Charlemagne joined the upper Rhine and the Danube, and

conceived the plan of connecting the Danube and the Main, probably less for trade purposes than as a means to solidify his empire. The last-named scheme was finally carried into execution in the nineteenth century by Louis I of Bavaria.

Europe, with its magnificent rivers, navigable, and easily rendered so by a canalization, rivers so easily joined by canals, was, nevertheless, very dilatory in developing artificial waterways. The reason may be found, perhaps, in the fact that Europe was divided into so many different states, and controlled by so many different governments.

CANALS OF EUROPE

The beginnings of Europe's great canal systems may be placed somewhere in the twelfth century, and the credit for practical inauguration belongs to the Dutch, although there are evidences that the British, as early as 1134, and the Italians somewhat later, did some work upon their waterways. The "low countries" were by nature peculiarly adapted for canalization, and to this day they have the greatest

mileage of canals compared with area. The aggregate mileage, including the part now known as Belgium, is given as over 3,400, the area as 24,000 square miles. This region, together with northeastern France, had by the year 1250 quite a respectable system of waterways.

But the great impulse to canal construction came after the invention of the use of locks, which enabled engineers to overcome the obstacles presented by elevations. This improvement is claimed for both Dutch and Italians; for the latter, at about 1481, for the former, nearly a hundred years earlier.

A lock is a prism, protected by sheer walls on either side and water-tight gates at either end. By opening the gates at the lower end, a vessel may be floated into this prism; then by closing the gates at the lower end of the lock and opening those at the upper end, the incoming water would raise the vessel to the higher level and permit it to continue its journey until the locking process, up or down, again became necessary. The invention of the lock was a truly wonderful contribution to water navigation. Probably it was not the work of any one mind, but was

borne in upon the minds of many, by the necessity of overcoming grade and the practical study of canal transportation. Prior to the lock, they overcame grades by means of an incline, up and down which vessels were hauled by means of capstans, the process being facilitated or rendered easier by a flush of water. They also removed the cargo from the boats and ran the boats upon trucks and, thus mounted upon wheels they were propelled up and down the incline by means of a windlass. The great improvement resulting from the invention of the lock was of little immediate use, as the prevalence of wars in Europe prevented the extensive development of waterways for more than a century.

HOLLAND

Holland's canal development has probably been the most remarkable; while most of the works were for inland transport, the magnificent ship canal, by which the port facilities of Amsterdam were, in 1826 and again in 1876, very materially enlarged, stands as one of the most noteworthy engineering feats.

It was built to develop the facilities of Amsterdam, as a natural seaport, to the expanding dimensions of ocean-going vessels; begun in 1865, and opened in 1876; length 16.7 miles. There are three locks, and a new one is planned larger even than those of Panama. The total cost, 1865-1907, was \$23,390,937; depth, 32.1 feet, which is greater than the average depth of the North Sea. The canal is large enough for all but ocean vessels of the very largest dimensions. The tonnage of vessels using the canal amounted to 1,401,128 in 1877, and to 8,583,066 in 1911; the number of vessels being 3,376 in 1877 and 28,799 in 1911. The canal is maintained by the state and no tolls are charged.

More recently the connection of that port and Rotterdam with the lower Rhine merits special notice. Always guarding her commercial interests, once far in advance of the rest of the world, and still, relatively to area and population occupying front rank, the little kingdom has not hesitated to make great sacrifices, temporarily, to attain the objects in view. Her canals are kept in efficient condition, and produce a steady increase in her commerce.

Besides its fine rivers, 360 miles in length, Holland has 2,408 miles of canals, and its waterway system is therefore large for a country having an area of only 12,741 square miles. Its Amsterdam Canal described above is one of the great ship canals of the world, and the whole country is a network of waterways—natural and artificial. No tolls or dues are charged on rivers or canals under governmental control. About 90 per cent of the freight traffic of the country is water-borne.

BELGIUM

Both railroads and waterways in Belgium are mostly owned and administered by the State, and it was reported to the British Royal Commission on Waterways that inland navigation in Belgium had been brought to the highest state of perfection, so as to be of value to every section of the country. There are about 100 waterways, of a total length of 1,345 miles. Upon these waterways Belgium has expended in improvements and maintenance over \$100,000,000 since 1831. Their traffic increased from 24,836,000

tons in 1888 to 53,345,000 tons in 1905, a gain of 120 per cent, while the gain in railroad traffic in the same time was 60 per cent. The Scheldt and Meuse Junction Canal extends from Antwerp to the Holland boundary, where it joins the Maestricht Canal, a distance of 95 miles. Recent enlargement to a depth of 8 feet 3 inches will make it navigable for 1,000 ton barges. There are 17 locks.

PRINCIPAL BELGIAN CANALS—1905

	<i>Length, miles</i>	<i>Traffic, tons</i>
Canal de Jonction.....	53.5	2,694,000
Bois le Duc Maestricht.....	27.6	2,011,000
Brussels to the Rupel.....	17.3	2,058,000
Charleroi to Brussels.....	45.5	1,042,000
Ostende-Bruges-Ghent.....	43.5	3,433,000
Terrenzen to Ghent.....	11.0	1,166,000

PRINCIPAL BELGIAN RIVERS—1905

	<i>Length, miles</i>	<i>Traffic, tons</i>
Bas Escant.....	67.0	9,974,000
Rupel.....	7.5	3,172,000
Haut Escant.....	59.0	2,628,000
Lys.....	70.0	3,337,000
Dendre.....	40.5	1,349,000
Sambre.....	58.0	2,121,000
Meuse.....	70.0	2,887,000

FRANCE

France began in 1605 the comprehensive system which has added over 3,000 miles of canals to her natural waterways. The greatest of her many works was the Languedoc, connecting the Mediterranean Sea and the Bay of Biscay, 148 miles, first opened in 1668. This connection was greatly improved in later centuries, the present Canal du Midi, 255 miles, being charged with a total cost exceeding \$100,000,000. But the important fact is that this canal system, owned by the government, has been well maintained.

France has 10,530 miles of waterways, of which 4,006 miles are in navigable rivers and 3,030 miles in canals with boats whose average capacity is 300 tons. Of the canals, the State owns and operates 2,860 miles. The government of France, from 1814 to 1900, expended in construction, improvement and maintenance of canals \$240,670,000, and on rivers \$216,170,000, a total of \$456,840,000. There have been no tolls on government waterways since 1888, during which year they were abolished.

Recently the Harbor and Navigation Commission of France recommended a total expenditure of \$212,300,000 for harbor improvements and internal navigation. The new canal construction works in course of completion (1913) are the following:

	<i>Share contributed by State, to January 1, 1912</i>
From Montbeliards to Haute Saone.....	\$ 2,474,684
Canal du Nord.....	11,266,182
From Marseilles to the Rhone.....	6,330,400
Total.....	\$20,071,266

The Canal d'Orleans is also being lengthened.

In 1912 there were on the inland waterways of France 15,141 boats capable of carrying 4,035,199 metric tons. As regards capacity, 78 per cent can carry over 300 tons. The canal-boats in common use are economical to build and operate, and about two-fifths of them are owned by the individuals who operate them. In 1912 there were 12,988 boats having cabins, with a population of 44,724 men, women and children living in them.

The following is a comparison between waterway and railroad traffic in France from 1886 to 1911:

TRAFFIC ON THE RAILROADS AND ON THE RIVERS OF
FRANCE

	<i>By railroads, tons</i>	<i>By navigable rivers and canals, tons</i>
1886.....	75,273,000	21,050,000
1896.....	105,900,000	29,534,000
1906.....	147,277,000	34,144,000
1907.....	159,115,000	34,702,000
1908.....	160,855,000	34,225,000
1909.....	167,734,000	35,627,000
1910.....	176,153,000	34,621,000
1911.....	187,362,000	38,117,000

Note: (a). In 1912 the waterway traffic was about 40,000,000 tons.

(b). Railroad tonnage increased 153.3 per cent from 1886 to 1911.

CLASSIFICATION OF MERCHANDISE TRANSPORTED ON
WATERWAYS IN FRANCE—TONS

	<i>1911</i>	<i>1910</i>	<i>1890</i>
Mineral fuels.....	12,434,000	11,369,000	6,945,000
Construction materials.....	15,968,000	11,948,000	7,688,000
Fertilizers.....	1,474,000	1,368,000	1,345,000
Fire wood.....	1,716,000	1,535,000	1,601,000
Metals and machinery.....	722,000	755,000	25,000
Raw materials (metal).....	1,607,000	1,710,000	1,713,000
Industrial products.....	1,317,000	1,222,000	678,000
Agricultural and food products	4,393,000	4,258,000	3,515,000
Miscellaneous.....	362,000	349,000	346,000
Woods of all kinds.....	124,000	107,000	312,000
Total.....	38,117,000	34,621,000	24,167,000

The latest statistics of waterway traffic are furnished by the French Ministry of Public Works for 1913 and 1912, as follows:

	¹ <i>Kilometric tons</i>	
	1913	1912
Total Canal Tonnage.....	3,235,918,464	3,164,916,147
Total River Tonnage.....	2,949,071,602	2,685,582,884
Total Waterway Tonnage.....	6,184,990,066	5,850,499,031

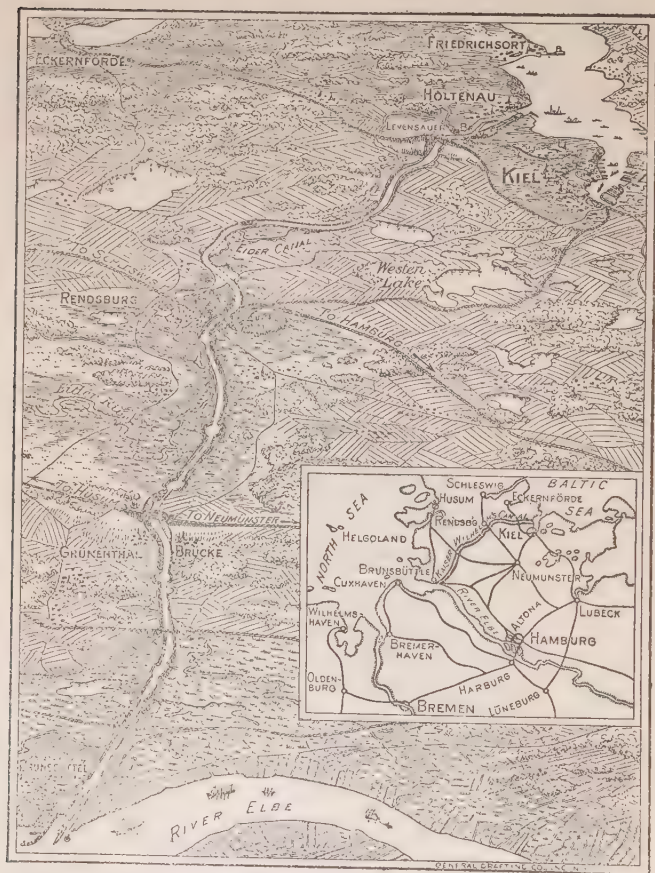
¹ Ton transported 1 kilometre (.621 of a mile).

GERMANY

Germany had canals connecting some of her great rivers prior to 1700, but the development of the present system was postponed to modern times. Once undertaken, however, it progressed rapidly, energetically, and with great practical results. Nearly all of her noble streams are connected at commercially strategic points, and no expense has been spared to accomplish the purpose in view.

KIEL CANAL

The Kaiser Wilhelm, or Kiel Canal, provides a waterway in Germany between Baltic and North Sea ports, thus avoiding the dangerous natural route around Denmark. It was begun in 1887 and completed in 1895, at a cost of \$37,128,000. Since then it has been reconstructed; this work beginning in 1907, was com-



Kaiser Wilhelm or Kiel Canal, connecting the North Sea with the Baltic Sea, and which in 1914 performed the double function of a highway for commerce and a haven of safety for the German fleet.

pleted in 1914, and opened by the Emperor on June 24th, 1914. As reconstructed, the Canal which is without locks, except at the two termini, will permit of the passage of modern warships and merchant vessels. It now has a minimum depth of 36.08 feet, a bottom width of 144.35 feet and a surface width of 334.64 feet. The length is 61 miles. During 1910, the number of vessels using the canal was 43,328, of 7,231,458 net tons. Less than half of the vessels were of steam, there being a large number of small sailing ships in the North and Baltic Seas. In 1896, 20,068 vessels of 1,751,065 tons passed through the Canal.

At the present writing, war existing between Germany and Austria on the one side, and England, France and Russia on the other, this canal is being used as a haven of safety by the German fleet; within its limits the fleet is absolutely safe, and from this point of vantage forays may be made whenever desirable occasion presents. The great military use of the canal is thus practically exemplified.

Not content with the great Kiel Ship Canal, a second and shorter route between these bodies

of water, *via* the rivers Elbe and Trave, for smaller craft, was opened in 1900.

In 1875 the length of navigable waterways (rivers and canals) in Germany was 7,656 miles. In that year began the new German policy of systematic reorganization and development of waterways, which has been maintained ever since. This has resulted in no great increase in mileage, which in 1900 was 7,843, a growth of 187 miles in 15 years, but there was, as stated by the German ambassador to the United States, a great advance in efficiency. All the improvements aimed to create a net of waterways which, east of Berlin assure the passage of vessels of 400 tons capacity, and west of Berlin of 600 tons capacity. Rivers were corrected, in a number of instances canalized, and the old canals reconstructed and new ones built. The canalization of the Main began in 1883, was opened in 1886 and the Spree-Oder Canal was completed in 1891. The capacity of the waterways varies from 2,000 ton vessels on the Rhine to 50 tons on the Oberland Canal. In 1907, 26,235 vessels of a tonnage of 5,914,020, operated on the inland waterways of Germany. Of these only 3,312

vessels of 188,762 tons were propelled by their own power; 1,213 had a capacity of 800 tons and upwards, and in 1905 the traffic carried amounted to 56,400,000 tons received and 47,000,000 despatched, a total of 103,400,000.

The following is a comparative table of railway and waterway traffic in Germany:

	<i>Waterways</i>	<i>Railways</i>
1875	20,800,000	167,000,000
1885	27,600,000	200,000,000
1895	46,700,000	331,000,000
1900	73,000,000	487,000,000
1905	103,400,000	588,700,000

Traffic arriving at all points on the Rhine in 1912 amounted to 61,189,316 tons, comparing with 54,222,152 tons in 1911.

The German government has recently granted permission for a canal from Muhlheim to the Rhine, having a depth of 13 feet, a width of 147 feet, and a capacity for 1,700 ton barges. The estimated cost is \$2,114,000.

The British Royal Commission on Canals and Waterways reported concerning the German waterways:

“That the use of natural and artificial waterways in cheapening the transport of coal and

other low value traffic increased the trade, industry and wealth of Germany, and so indirectly the revenue derived by the railways from passenger traffic and high class goods."

Count von Bernstorff, the German Ambassador, says:

"The transport by water being cheaper than that by railways, the further improvement of the German waterways promises to be useful to the German industrial life."

GREAT BRITAIN

British canals are nearly all privately owned, one third of them by railroads. Tolls are levied. There are 4,673 miles of inland "canals and navigation" in the United Kingdom, the capital raised for their construction and improvement being \$237,753,840. Their revenue in 1905 amounted to \$13,403,500, of which \$6,596,020 was received from tolls. The expenditures were \$9,456,065, leaving a profit of \$3,947,485. Their traffic aggregated in that year 43,161,926 tons. These results have been attained in spite of the fact of the large number of locks, the payment

of tolls and the limited carrying capacity of the boats, usually only 30 to 60 tons.

In England and Wales alone there are 4,033 miles of waterway, which in 1905 carried 37,500,000 tons, and it is understood that the traffic has not increased much since that time. This waterway traffic compares with 109,000,000 tons carried on the English railroad systems in 1911. The following are the nine principal waterways in England, with their traffic and net revenue in 1905:

<i>Waterway</i>	<i>Mileage</i>	<i>Tonnage conveyed</i>	<i>Net revenue</i>
Birmingham Canal.....	159	7,546,000	£ 91,607
Aire and Calder Navigation...	85	2,810,000	111,511
Leeds and Liverpool Canal ...	145	2,467,000	37,629
Grand Junction Canal	189	1,794,000	51,328
Thames River—above London			
Bridge to Inglesham.....	144	1,395,000	6,588 loss
Trent and Mersey Canal	119	1,137,000	15,883
Regent's Canal.....	11	1,045,000	52,991
Weaver Navigation.....	20	1,076,000	2,247
Sheffield and South Yorkshire			
Navigation.....	60	835,000	24,005
	932	20,105,000	£381,143

A Royal Commission on Canals and Waterways, after four years of investigation, has rendered an elaborate report with the object of modernizing and nationalizing the British Canal systems.

In Scotland canals of the old type have deteriorated, but there is now reviving interest in waterway improvements, and among the projects is a deep water canal to connect the Firth of Forth and the Firth of Clyde, so as to eliminate a 400 mile route around the rough north coast line of Scotland. The largest canal of Scotland is the Caledonian, from Inverness to Ft. William, and is navigable by vessels 150 feet in length, with 17 feet draught.

Ireland's Grand Canal, 165 miles long, connecting Dublin with the River Shannon and other points, is its chief waterway.

England's most important canal contribution was promoted by the Duke of Bridgewater, in 1757, connecting Manchester and Liverpool and which, by process of evolution, has become the large and improved Manchester Ship Canal.

MANCHESTER SHIP CANAL

It extends $35\frac{1}{2}$ miles from Manchester to Eastham on the River Mersey, six miles from Liverpool. The canal makes a seaport of Manchester, and is one of the most remarkable artificial waterway achievements in existence. Its

depth, originally 26 feet, has been increased to 28 feet, with a bottom width of 120 feet. Five sets of locks overcome a difference in elevation of 58 feet 6 inches. The canal was begun in 1887 and opened for traffic in 1894. The cost was £14,860,000, but other canal, railway and dock construction increased the amount; and the total authorized capital on December 31, 1913, was £19,573,230, of which £17,123,230 was created. The total net income was £356,077, and the balance after payment of fixed charges was £46,166. Of this £22,288 was appropriated to reserve and £23,877 ($2\frac{1}{4}$ per cent) was available for the corporation's $3\frac{1}{2}$ per cent preference stock. In 1894, when the canal was opened, the sea-borne traffic was 686,158 tons, the barge traffic 239,501 tons, total 925,659 tons; the total receipts being £97,901.

Traffic and receipts during the past six years:

	<i>Sea-borne traffic tons</i>	<i>Barge traffic tons</i>	<i>Total tons</i>	<i>Tolls and other receipts</i>
1913.....	5,457,218	322,943	5,780,161	£654,937
1912.....	5,021,691	318,193	5,339,884	605,179
1911.....	4,894,670	323,142	5,217,812	580,841
1910.....	4,618,070	319,561	4,937,631	555,735
1909.....	4,290,765	272,636	4,563,401	534,059
1908.....	4,317,965	264,531	4,582,496	506,975

DENMARK

Denmark, when it owned Holstein, had a Baltic-North Sea canal, part of which is now used for the new Kiel Ship Canal; otherwise its system is purely local and not extensive.

RUSSIA

In Russia, Peter the Great was the first builder of important canals; he began by connecting his capital on the Neva, by way of the Volga, with the Caspian Sea, to reach more expeditiously the caravan trade of southwestern Asia, upon which the Muscovite has for centuries had his eyes. Subsequently connection was made with the ports on the Arctic Ocean; the Black and the Caspian seas and the rivers Dniester and Vistula, were joined, the latter involving 461 miles of canal and river way, said to have cost over \$100,000,000. The recently finished Cronstadt-St. Petersburg Canal cost \$10,000,000, for its six miles of 20½ feet depth. The more ambitious project of making a 27-foot waterway,

from the Black Sea to the Baltic, 1,000 miles, to cost nearly \$100,000,000, is the latest proposed addition to Russia's means for commercial expansion.

In Russia there are rivers, lakes and canals having a total mileage of 239,161, of which 178,580 miles are now navigable, although only one-third of this length is navigable by steamers. The artificial waterways have a length of 1,225 miles, of which 505 are canals and 556 natural water courses canalized. About one-third of Russia's freight is transported by water, and the proportion has varied little in the past thirty years. Waterway traffic has increased in about the same percentage as railroad traffic. The appropriations for waterway development in 1912 amounted to \$12,104,000 and in 1911 to \$10,308,000. From 1906 to 1910 they averaged \$8,480,500 a year. It was decided in 1912 to reconstruct the Mariinsky Canal by building five new locks on the River Sheksna at a cost of \$4,000,000. The River Dnieper is being improved for 247 miles, at a cost of \$15,231,125, to be spread over several years.

AUSTRIA-HUNGARY

Austria-Hungary is crossed by the great Danube River, a great water thoroughfare. Her canal system is by no means famous, but nevertheless important, as it connects all parts of the dual kingdom with this great river, and is therefore necessarily local in character. Her canals add 1,700 miles to her 5,500 miles of natural waterways.

A project to connect the Danube with the Oder and the Elbe is under consideration.

SWEDEN

Sweden began canalization early in the seventeenth century and has maintained a system serving the interests of several interior commercial cities; but the system is chiefly local, her topography not calling for trunk canals.

ITALY

The topography of Italy does not lend itself to canalization; the country is very long and narrow,

and traversed longitudinally by mountain ranges, contained between the Mediterranean and the Adriatic; there are no long distances to the sea shore and no long rivers, the Po being the most important. It has 967 miles of navigable rivers and about 655 miles of canals. The canals are almost wholly in the extreme north, in the valley of the Po, in Piedmont, Lombardy and Venetia; they possess local importance, are largely used and of great value to local trade.

CORINTH

The Corinth Ship Canal cuts the Isthmus of Corinth and connects the Gulf of Corinth and the Saronic Gulf, is about 4 miles long, 70 feet wide and 26 feet deep; it shortens the journey from the Adriatic to the Ægean Sea 202 miles. Large steamships seldom make use of it, however, as the narrowness of the canal and the very strong current passing through the same at times, render passage dangerous.

This canal was begun by Nero, A. D. 67; a French company took up the work in 1881 and it was completed by a Greek company and

opened for public use, in 1893. Widened and protected against currents at its termini, and a proper system of towage provided, this canal would possess great commercial and military importance.

SPAIN

Spain has, in the matter of canals, as in many other respects, failed to keep abreast of her neighbors. Her long cherished plan of joining the Mediterranean Sea and the Bay of Biscay remains in abeyance, being less than half built at the present time. In the reign of Charles II, the Council of Castile opposed canal plans, as an interference with the wisdom of Divine Providence, which had fixed the waterways.

INDIA

India has one of the world's longest canals, that of Bengal, 900 miles; there are two others of about 600 and 450 miles respectively, but these are primarily for irrigation purposes; there are many lesser ones employed for transportation.

CHINA

China's comprehensive canal building probably began in the seventh century; we are told that her Grand Canal, connecting her capital with tidewater at Canton, and branching to other points, finished about the end of the thirteenth century, was 600 years in construction; including canalized rivers, its length exceeds 1,000 miles, the longest navigable waterway in the world. Lesser ones, none modern, ramify the entire country, which until very recently had not a mile of railway. The system comprises 5,300 miles and has proved indispensable to the existence of that teeming empire; with its aid the great problem of subsisting 400,000,000 human beings was solved; not only are transportation facilities and irrigation provided, the canals also supply an abundance of fish, and from their beds is drawn a mass of muck to fertilize the soil.

SUEZ

The Suez Canal was conceived by the distinguished Frenchman, Ferdinand De Lesseps,

and carried to successful completion under his engineering ability and direction. It connects the Mediterranean Sea and the waters of the Indian Ocean, Port Said being its northern terminal, and Suez its southern terminal. It eliminates the long, tedious voyage around the Cape of Good Hope and reduces the route of valuable European Oriental trade by at least one-third.

It was an epoch-making event in ocean navigation and until the completion of the Panama Canal, it was beyond comparison the most important and most useful of all artificial waterways.

The Suez Canal is a sea-level ship canal; opened for traffic November 17, 1869; 87 nautical miles in length; depth (1908) 10 meters, or 32 feet 9 inches, and maximum vessel draught of 8.53 meters, or 28 feet. A depth of 11 meters, or 36 feet 1 inch, is planned, and by January 1, 1915, it is expected that the authorized vessel draught will be 9 meters 14 centimeters, or 30 feet. The canal is carried on the company's books at a value of 679,522,001 francs (about \$136,000,000) and the company has other assets of 84,184,053 francs. The average time in passing through the canal in 1913 was 16 hours and 19

minutes. A high record total of 25,775,000 tons of goods was transported. The size of vessels using the canal averaged 3,940 tons in 1913 as compared with 3,774 in 1912. Canal dues now stand at 6.25 francs per net ton. The total canal receipts from all sources in 1913 were 129,925,949 francs, or 9,996,690 francs less than in 1912, of which 9,748,899 francs was due to reduction in transit receipts. The canal has proved highly profitable to its owners; and in 1911 could pay a dividend of 33 per cent from tolls of \$1.30 per net ton. In 1913 the tolls were reduced to 6.25 francs, or \$1.206.

TRAFFIC AND RECEIPTS FROM TOLLS

	<i>No. vessels</i>	<i>Tonnage net</i>	<i>Receipts from tolls</i>
1908.....	3,795	13,633,283	105,396,205 fr.
1909.....	4,239	15,407,527	117,754,888
1910.....	4,533	16,581,898	127,203,295
1911.....	4,969	18,324,794	131,035,232
1912.....	5,373	20,275,120	132,929,341
1913.....	5,085	20,033,884	122,989,367

	<i>No. passengers</i>	<i>Receipts</i>
1908.....	218,967	2,189,675 fr.
1909.....	213,122	2,131,220
1910.....	234,320	2,343,202
1911.....	275,259	2,752,595
1912.....	266,403	2,499,020
1913.....	282,235	2,653,340

During the first five months (Jan. 1 to May 31) of 1914, there were 2,222 vessels passing through the canal, with receipts of 55,580,000 francs, against 2,178 vessels and receipts of 53,230,000 francs in 1913, and 2,392 vessels and receipts of 59,320,000 francs in 1912. The canal is owned and operated by a French company, in which the British government holds a preponderating interest.

Although the records indicate that the Peruvians had canals, these were probably irrigation works; certain it is that commercial canals in the western hemisphere are confined to North America, and practically to the United States and Canada, where numerous noteworthy examples exist. The five great inland seas naturally first attracted attention; their connection with tidewater has given the engineering profession abundant opportunity to display their skill, and the more distinctly local undertakings of joining the great rivers with each other and with the great lakes, have employed the energies of all progressive citizens.

In the United States alone, the total mileage of canal works is placed at 4,479 (see Appendix Table No. 1), of which, however, nearly 2,000 miles have been abandoned. The cost, up to 1900, is estimated to have been \$220,000,000. The works of special note are the Erie, in New York State; the Cincinnati and Erie, in Ohio; the Chesapeake and Ohio, and the Saulte Ste. Marie, in Michigan. The last named was opened in 1855; the parallel Canadian canal, around the same Falls, was opened in 1895; together their tonnage in 1913 was 79,721,525.

Canada has also an important canal around St. Mary's Falls (opened 1895). For the purpose of getting around the Niagara Falls, Canada built the Welland Canal, a very expensive work, but commercially of the first importance. She has many lesser canals, and by means of her system has builded an enormous volume of commerce. It is estimated that Canada has spent fully \$110,000,000 upon artificial waterways, the largest, relative to population and period of construction, on record. We shall presently consider the effect of this policy upon her commerce.

Mulhall, the eminent British statistician, gives the mileage of existing canals and rivers in use, in Europe, at over 77,000, of which 13,293 miles are canals. In the United States the canal mileage is reported as 4,479, the mileage of other waterways as 47,355; while Canada has 535 miles of canals and 3,800 of rivers. The total of the world's canals reaches about 26,000 miles; the cost has been in excess of \$2,000,000,000.

It was natural that the advent of railways should interfere, in most countries, with the development and profitableness of canals. In only a few have the two systems been used jointly and improved equally. The more speedy transit furnished by rail is the chief factor in attracting freight at the expense of the slower canal transportation. This has been specially noticeable in the United States. But the question of cheapening transportation has again come to the fore; expert testimony shows that by means of properly adapted waterways the charge is at least one-third less, and this is accomplished by the expenditure of one-thirtieth the hauling power. This fact, and the enormous increase in traffic, have revived interest in the

subject of waterways throughout the civilized world. The prices of necessities of life have been enhanced by a multitude of causes, and the world is endeavoring to reduce the part of the cost due to transportation.

THE CANAL SYSTEM OF NEW YORK

THE PERIOD OF INCEPTION

THE value, nay the imperative need, of artificial connections between the inland lakes and rivers of the United States and the streams emptying into the Atlantic Ocean, impressed itself upon the far-seeing men of the days before the Revolution, when the migration of the most venturesome of the population toward the west began. Particularly in New York was this the case; for thriving settlements had sprung into existence along the banks of her beautiful rivers. Albany was already a place of considerable importance, and the valley of the Mohawk boasted a number of hamlets. As early as 1724, Cadwalader Colden, Surveyor General, subsequently Lieutenant Governor of the colony, after an exploration of a part of the region, pictured a future "scene of inland navigation such as cannot be paralleled in any other part of the world." In 1768, Governor Moore, in a message to the New York General Assembly, called at-

tention to the obstruction to navigation of the Mohawk River occasioned by the Falls of Canajoharie, and recommended that this be removed by sluices upon the plan of the Languedoc Canal in France. Gouverneur Morris, as early as 1777, predicted the eventual union of the waters of the Lakes with those of the Hudson and the Atlantic.

George Washington, with the practical appreciation of an engineer and surveyor, immediately after the close of the Revolutionary War, urged the utilization of all natural facilities for connecting the middle west with the seaboard. Nowhere did the natural barriers presented by the Appalachian range of mountains between the seaboard and the vast territory to the west, offer so feasible a route as that to be found in New York State; the Hudson River, carrying tidewater through a mountain cleft for a distance of 150 miles; its tributary, the Mohawk, extending westward almost to the smaller lakes, which practically formed a chain to the great inland sea, Ontario, and brought one within a comparatively short distance of Erie; these were ideal conditions for canalization.

Washington had familiarized himself with the general topography of the region by an exploration undertaken in company with Governor George Clinton and Alexander Hamilton, in 1783. He thus became an intelligent and persistent advocate of the plans which then began to take shape among the New Yorkers. Washington's view was not wholly the commercial one; to him it was also a question of binding the people of the nation together for the purpose of perpetuating the Union. If the sturdy pioneers who, out of the narrow Indian trails were hewing roads through the wilderness, planting settlements here and there, but ever farther westward, were to be deprived of adequate means of communication with the east, they would find an outlet by way of the great Mississippi and its tributaries, then in large part in alien hands, with thriving trade centres at St. Louis and other points, and an important port in New Orleans. Louisiana belonged to France, and comprehended the Mississippi Valley as far north as Minnesota, where the French had an important trading post, Hennepin, now Minneapolis. France claimed the country drained

by the Mississippi and its tributaries; on the west there was no one to dispute their claim, and on the east the struggling settlers from the Atlantic states were not numerous enough or strong enough to present much opposition. The eastern boundary of Louisiana was wholly undetermined and later formed the basis of much fighting. The French had Fort Duquesne, the present site of Pittsburg, from which General Braddock, of unfortunate memory, aided by Washington, sought in vain to dislodge them.

With Washington, as with Charlemagne, artificial waterways represented links in the chain which should hold together the empire. The great and fertile country west of the Alleghanies was likely to become a distinct political entity, or the province of a foreign power, and thus be wholly estranged from the seaboard states, unless the seaboard bestirred itself to maintain close relations.

The Erie Canal played a most important part in retaining and binding to the Atlantic states this great middle west, and when Napoleon sold us Louisiana, the Great Lakes region, through the service of the Erie Canal, became intimately

bound to the east by the reciprocal bonds of commerce.

But the country was poor; the devastating War of Independence had left the people struggling to maintain existence; a totally inadequate political system had first to be done away with and a sound constitutional government of united states established. The repudiation of State debts had made it most difficult to borrow money for novel enterprises, and increasing already burdensome taxes was impracticable. As an illustration we have the experience of Christopher Coles, an engineer of note, who had made a survey of the Mohawk Valley in 1784; he submitted plans to the New York legislature for the connection of the Hudson River and Lake Ontario. He and his associates were tendered the profits of the scheme in perpetuity if they would only carry it out; but he failed to enlist the requisite financial assistance. It is almost pathetic to read that the legislature appropriated the munificent sum of \$125 to enable Coles to complete his surveys.

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legislature through the efforts of Governor George Clinton. In 1792 two companies were chartered, one to construct a canal to connect the Hudson River with Lake Champlain, which, however, "fell by the wayside;" the other, the "Western Inland Navigation Company," to connect the Hudson and Lake Ontario. The State took 200 shares of the \$25 stock of the company and loaned it £15,000 on mortgage, for which it also later took stock. With this support something was actually accomplished; by the end of 1796 the company had six miles of canal at and about Little Falls, navigable by 16-ton vessels, to facilitate the use of the upper Mohawk; the work cost \$400,000. Soon thereafter connection was made between the Oswego River (flowing into Lake Ontario) and Cayuga and Seneca Lakes. This initial canal work was done by William Weston, afterwards Superintendent of Canals. Among the most earnest supporters were Thomas Eddy, the philanthropist, and Stephen Van Rensselaer, the patroon. These men saw in the project for the Erie waterway a means by which New York City would obtain the commerce of the great West "forever" with-

out need of fearing rivalry; the City would thereby become "the greatest commercial emporium of the world, excepting, eventually perhaps, New Orleans or some other depot at the mouth of the majestic Mississippi." The thought that anything could supersede water transportation was evidently far from their minds.

Notwithstanding all the arguments and discussions and the obvious interest of the State, notwithstanding the enormous cost of transportation, estimated to have been \$100 per ton from Buffalo to New York, many years were to pass before anything further was done toward a canal system. The people who were building up the central and western parts of the State felt the need of better transit facilities. Ohio was coming into prominence as a producing territory and a commercial field, soon (in 1803) to become one of the sisterhood of States. Indiana, Michigan, Illinois and Wisconsin were now the outer territories, but, rapidly growing. Here was an empire to be exploited commercially. But the people of New York City and the southern end of the State, to whom the benefits to accrue, naturally perhaps, appeared more remote, were for a long

time only mildly affected by the agitation. The enthusiasm of Gouverneur Morris, who told them among other things that he foresaw the time when ships would "sail from London through the Hudson River to Lake Erie" by a splendid canal, failed to impress them. This patriotic citizen, then a Senator in Congress, was joined by De Witt Clinton, whose name is associated with New York's canal system for all time. It was uphill work; the support of the people of the lower end of the State was necessary, and the influence of the opposition, the "bourbons" of the period, among whom were the leading "sachems" of the Tammany Hall of that day, was difficult to overcome. The expense of the enterprise, a present bugaboo, overshadowed the prospect of much greater future benefits.

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and poles to be used in case of a calm; these made 18 to 20 miles per day, consuming the better part of a week; to Oswego, 114 miles further, took another nine days. On the Hudson River freight rates averaged 40 cents per hundred-weight; the small canals already referred to, charged \$2.25 to \$3 per ton. On the Mohawk the rate was 75 cents per hundredweight to Utica and \$1.25 on the western section from Utica to Oswego, making a total of about \$50 per ton from New York to Oswego. There was much dissatisfaction at the charges imposed by the canal company, and comparatively large quantities of freight were taken overland in that section, owing to the exorbitant rates.

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canals, a project which had the full approval of Albert Gallatin and the other broad-gauge members of the Jefferson party, gave New Yorkers hope that they would receive support from the National government. In 1808, the New York legislature, at the behest of Joshua Forman of Onondaga, and Thomas R. Gold, of Oneida, appointed a committee to consider plans for a canal to Lake Erie, with a view to obtaining aid from Congress by an appropriation to accomplish "that great national object." It was declared that "while this State would forbear to derogate from the claims of others, she felt warranted in presenting to the government of the Union her own territory as preëminently distinguished for commercial advantage."

Simeon De Witt, the Surveyor General, was directed to cause the route suggested to be accurately surveyed, and the sum of six hundred dollars (\$600!) was appropriated by the legislature for the purpose. The survey demonstrated the complete availability of the route which was later adopted. De Witt, who was appointed Surveyor General in 1784, held that office continuously for fifty years, covering thus the entire

period of the conception, birth, and first growth of the canal system, to the promotion of which he gave his life service.

It was not until 1810, however, that a Canal Commission was actually provided for by the legislature; it included besides Morris, Clinton and De Witt, William North, Thomas Eddy and Peter B. Porter. In 1811 Robert Fulton and Robert E. Livingston were added. A thorough exploration at this time produced an estimate of cost of a canal to Lake Erie at \$5,000,000. Morris and Clinton were sent to Washington to endeavor to obtain support from the Federal government, but President Madison was not favorable to the use of public money for this purpose, and the committee returned to New York disappointed.

The scope of the canal enterprise was rightly considered national in character. While Madison and Monroe were solicitous that the canal be built, as strict constructionists, they believed that no aid could be extended without first amending the Federal Constitution. Gouverneur Morris urged that the Federal government should build the canal, and its operation and

control should be regulated by "treaty" between the State and nation. In this proposition we see the then conception of "State sovereignty," and how lightly the bonds of union were regarded; and also observe that the question of the regulation of interstate commerce was early brought into prominence. The "general welfare" clause of the organic law had not yet been elaborated.

The War of 1812, with its burdens and responsibilities, eliminated the Federal government as a possible builder of the canal.

The agitation was continued throughout the State, especially by Clinton, after his defeat for the Presidency; and in June, 1812, the legislature passed an act authorizing the Canal Commission to borrow money and accept grants of land preparatory to the beginning of work. But borrowing money during the war was out of the question, and the progress of the enterprise halted. In 1816, Governor Tompkins strongly urged that the State proceed to build the canal without further delay. A new Commission was created with Clinton at its head, further surveys were made, and more elaborate estimates of costs pre-

pared, which included connection with Lake Champlain as well as with Lake Erie. The width of the canal was to be 40 feet at surface, 28 feet at bottom, and the depth 4 feet. The estimate of cost was \$5,442,813. On April 15, 1817, the legislature terminated the long speculation by actually authorizing the construction of the canal, creating a Canal Board, consisting of all the executive State officers except the Governor, which was given power to borrow money on the credit of the State. The canal fund created was to be under their charge. The Clinton Commission was continued, charged with the duty of construction, operation and maintenance. This division of authority soon caused difficulties which resulted in vesting the power of both in a differently constituted board, created in 1826.

The patronage of the canal appealed to the selfishness of men and involved in its construction the vicissitudes of party politics, engendering the fiercest political and personal animosities. Clinton was not above using the patronage to regain and promote his political prestige, but above all things he devoted his energies to the

success of the canal. He boldly made it the issue in the gubernatorial campaign of 1817; he compelled his nomination for the Governorship and defeated his opponent, Peter B. Porter, one of his colleagues on the Canal Commission of 1810, by the decisive total of 43,310 votes against 1,479, a most extraordinary expression of public opinion and confidence.

His inauguration took place on July 1, 1817, and three days later, on the nation's chief holiday, he had the supreme satisfaction of breaking ground for the canal at Rome, then a promising village on the Mohawk River (formerly Fort Stanwix), amid great ceremony and jubilation. Samuel Young, one of the Canal Commissioners, in his address, said:

"By this great highway, unborn millions will easily transport their surplus productions to the shores of the Atlantic, procure their supplies, and hold a useful and profitable intercourse with all the maritime nations of the earth."

Thus, after thirty years from the date when his uncle, George Clinton, had urged the matter upon the people, they finally, under the leadership of the nephew of the first Governor, se-

riously began work. The little canals of the Western Inland Navigation Company, already referred to, were bought for \$152,718; extension was pushed vigorously, and by October, 1819, the section between Rome and Utica, 15 miles, was open to navigation. In November of the same year boats from the Hudson River passed into Lake Champlain; in 1820 the Erie reached the Seneca River, and it was confidently reported that it would be completed by 1823. In this hope Clinton was disappointed, and his opponents made the most of the delay.

The control of the, for that day, vast patronage of the canal, intensified political rancor and gave to politics a vehemence and virulence unprecedented. Clinton was charged with everything from bankrupting the State to plotting secession of New York from the Union. Although reëlected Governor in 1820, over Tompkins, who now opposed the canal, his majority was so slender and his hold upon the people so precarious during the second term, that he was compelled to retire from the contest for a third nomination in 1822. In April, 1824, he was removed from the position of Canal Commissioner,

which he had held continuously from the creation of the original Commission in 1810, even while Governor. This humiliation, believed at the time to be his political deathblow, was accomplished by the overwhelming vote of the legislature, dominated by Van Buren, William L. Marcy, Silas Wright and their associates, who had now become all-powerful as the "Albany Regency."

But, after all, the people wanted the canal; the new régime was not apparently making satisfactory progress. Clinton took advantage of the situation, accepted a nomination for the Governorship in 1824, and in the Fall of that year, scarcely six months after his humiliation, he was elected by a vote of 103,452 against 87,093. With Clinton again in the harness, the canal work progressed at a lively pace; and again he experienced the satisfaction of presiding over the destinies of the State officially when, on October 26, 1825, the first boat to make the trip through the finished Erie Canal left Buffalo, with the Governor, Stephen Van Rensselaer, Joshua Forman, Chancellor Livingston, William L. Stone and Thurlow Weed among those on

board; conspicuous by their absence were the members of the "Albany Regency."

The trip of the "Seneca Chief," as the canal-boat was named, was probably the most thoroughly celebrated event New York State has ever experienced. All along the route was a jubilant people, making it a continuous holiday parade; ringing of bells and booming of cannon greeted it everywhere; and Clinton was the hero of the fortnight. On November 4, the boat, escorted from Albany by a fleet of steamers arrived in New York City, where civic, military and naval parades followed, accompanied by the most extravagant demonstrations of popular enthusiasm. A memorial medal was struck by the municipal authorities, the face of which was subsequently adopted as the seal of the Canal Department. Two kegs of water from Lake Erie had been brought along, and one of these was taken to Sandy Hook and the water ceremoniously poured into the Atlantic Ocean, the contents of the other keg were bottled as mementos, and one of these bottles was presented to Lafayette, who had a short time before been the guest of the City. Governor Clinton poured

tention to the obstruction to navigation of the Mohawk River occasioned by the Falls of Canajoharie, and recommended that this be removed by sluices upon the plan of the Languedoc Canal in France. Gouverneur Morris, as early as 1777, predicted the eventual union of the waters of the Lakes with those of the Hudson and the Atlantic.

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"MARRIAGE OF THE WATERS."

Gov. Clinton pouring water from Lake Erie into the Atlantic at Sandy Hook.
From a Mural Painting in DeWitt Clinton High School. Copyright, 1905, by C. V. Turner.

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Simeon De Witt, the Surveyor General, was directed to cause the route suggested to be accurately surveyed, and the sum of six hundred dollars (\$600!) was appropriated by the legislature for the purpose. The survey demonstrated the complete availability of the route which was later adopted. De Witt, who was appointed Surveyor General in 1784, held that office continuously for fifty years, covering thus the entire

period of the conception, birth, and first growth of the canal system, to the promotion of which he gave his life service.

It was not until 1810, however, that a Canal Commission was actually provided for by the legislature; it included besides Morris, Clinton and De Witt, William North, Thomas Eddy and Peter B. Porter. In 1811 Robert Fulton and Robert E. Livingston were added. A thorough exploration at this time produced an estimate of cost of a canal to Lake Erie at \$5,000,000. Morris and Clinton were sent to Washington to endeavor to obtain support from the Federal government, but President Madison was not favorable to the use of public money for this purpose, and the committee returned to New York disappointed.

The scope of the canal enterprise was rightly considered national in character. While Madison and Monroe were solicitous that the canal be built, as strict constructionists, they believed that no aid could be extended without first amending the Federal Constitution. Gouverneur Morris urged that the Federal government should build the canal, and its operation and

control should be regulated by "treaty" between the State and nation. In this proposition we see the then conception of "State sovereignty," and how lightly the bonds of union were regarded; and also observe that the question of the regulation of interstate commerce was early brought into prominence. The "general welfare" clause of the organic law had not yet been elaborated.

The War of 1812, with its burdens and responsibilities, eliminated the Federal government as a possible builder of the canal.

The agitation was continued throughout the State, especially by Clinton, after his defeat for the Presidency; and in June, 1812, the legislature passed an act authorizing the Canal Commission to borrow money and accept grants of land preparatory to the beginning of work. But borrowing money during the war was out of the question, and the progress of the enterprise halted. In 1816, Governor Tompkins strongly urged that the State proceed to build the canal without further delay. A new Commission was created with Clinton at its head, further surveys were made, and more elaborate estimates of costs pre-

pared, which included connection with Lake Champlain as well as with Lake Erie. The width of the canal was to be 40 feet at surface, 28 feet at bottom, and the depth 4 feet. The estimate of cost was \$5,442,813. On April 15, 1817, the legislature terminated the long speculation by actually authorizing the construction of the canal, creating a Canal Board, consisting of all the executive State officers except the Governor, which was given power to borrow money on the credit of the State. The canal fund created was to be under their charge. The Clinton Commission was continued, charged with the duty of construction, operation and maintenance. This division of authority soon caused difficulties which resulted in vesting the power of both in a differently constituted board, created in 1826.

The patronage of the canal appealed to the selfishness of men and involved in its construction the vicissitudes of party politics, engendering the fiercest political and personal animosities. Clinton was not above using the patronage to regain and promote his political prestige, but above all things he devoted his energies to the

success of the canal. He boldly made it the issue in the gubernatorial campaign of 1817; he compelled his nomination for the Governorship and defeated his opponent, Peter B. Porter, one of his colleagues on the Canal Commission of 1810, by the decisive total of 43,310 votes against 1,479, a most extraordinary expression of public opinion and confidence.

His inauguration took place on July 1, 1817, and three days later, on the nation's chief holiday, he had the supreme satisfaction of breaking ground for the canal at Rome, then a promising village on the Mohawk River (formerly Fort Stanwix), amid great ceremony and jubilation. Samuel Young, one of the Canal Commissioners, in his address, said:

“By this great highway, unborn millions will easily transport their surplus productions to the shores of the Atlantic, procure their supplies, and hold a useful and profitable intercourse with all the maritime nations of the earth.”

Thus, after thirty years from the date when his uncle, George Clinton, had urged the matter upon the people, they finally, under the leadership of the nephew of the first Governor, se-

riously began work. The little canals of the Western Inland Navigation Company, already referred to, were bought for \$152,718; extension was pushed vigorously, and by October, 1819, the section between Rome and Utica, 15 miles, was open to navigation. In November of the same year boats from the Hudson River passed into Lake Champlain; in 1820 the Erie reached the Seneca River, and it was confidently reported that it would be completed by 1823. In this hope Clinton was disappointed, and his opponents made the most of the delay.

The control of the, for that day, vast patronage of the canal, intensified political rancor and gave to politics a vehemence and virulence unprecedented. Clinton was charged with everything from bankrupting the State to plotting secession of New York from the Union. Although reëlected Governor in 1820, over Tompkins, who now opposed the canal, his majority was so slender and his hold upon the people so precarious during the second term, that he was compelled to retire from the contest for a third nomination in 1822. In April, 1824, he was removed from the position of Canal Commissioner,

which he had held continuously from the creation of the original Commission in 1810, even while Governor. This humiliation, believed at the time to be his political deathblow, was accomplished by the overwhelming vote of the legislature, dominated by Van Buren, William L. Marcy, Silas Wright and their associates, who had now become all-powerful as the "Albany Regency."

But, after all, the people wanted the canal; the new régime was not apparently making satisfactory progress. Clinton took advantage of the situation, accepted a nomination for the Governorship in 1824, and in the Fall of that year, scarcely six months after his humiliation, he was elected by a vote of 103,452 against 87,093. With Clinton again in the harness, the canal work progressed at a lively pace; and again he experienced the satisfaction of presiding over the destinies of the State officially when, on October 26, 1825, the first boat to make the trip through the finished Erie Canal left Buffalo, with the Governor, Stephen Van Rensselaer, Joshua Forman, Chancellor Livingston, William L. Stone and Thurlow Weed among those on

board; conspicuous by their absence were the members of the "Albany Regency."

The trip of the "Seneca Chief," as the canal-boat was named, was probably the most thoroughly celebrated event New York State has ever experienced. All along the route was a jubilant people, making it a continuous holiday parade; ringing of bells and booming of cannon greeted it everywhere; and Clinton was the hero of the fortnight. On November 4, the boat, escorted from Albany by a fleet of steamers arrived in New York City, where civic, military and naval parades followed, accompanied by the most extravagant demonstrations of popular enthusiasm. A memorial medal was struck by the municipal authorities, the face of which was subsequently adopted as the seal of the Canal Department. Two kegs of water from Lake Erie had been brought along, and one of these was taken to Sandy Hook and the water ceremoniously poured into the Atlantic Ocean, the contents of the other keg were bottled as mementos, and one of these bottles was presented to Lafayette, who had a short time before been the guest of the City. Governor Clinton poured

Other railway companies were also entering the field and becoming important competitors. It would appear, therefore, that the railways profited very largely from the closure, by the Civil War, of southern outlets for the commerce of the western States. The canals also benefited, but there were clear indications that the land lines were gaining in greater proportion. There was still an advantage on the side of the canals in the lower classes of freight for the long-haul, as shown by the tonnage returns, but this advantage was destined also to be lost to them later, particularly after the New York Central and Hudson River railroads were consolidated in 1869. This was obviously the time for the friends of the canal system to demand further improvements.

Another constitutional convention was held in the year 1867, and much attention was given to the canals. But the convention recommendations in general were upon partisan lines, and were emphatically rejected by the popular vote. The discussion gives us some interesting information. Thus, while it was well known that the canals had been yielding handsome revenues,

nevertheless the debt and the interest thereon were considered a burden. Were interest payments also reckoned, claimed the short-sighted ones, the canal system would be shown to have been very costly. In response data were furnished showing the total cost to 1867, with interest thereon at 7 per cent, the legal rate at the time; the expense for operation, maintenance and repairs, likewise with interest, and, upon the other hand, the total revenues and the interest which these might have earned at the same rate; with the result showing that the State had given less than \$7,500,000 more than it received.

The figures follow:

Cost of construction and improvement	\$64,710,837	interest thereon	\$ 93,736,655
Cost of operation, maintenance and repairs . . .	24,377,114	interest thereon	27,268,895
Total outgo	\$89,087,951	interest thereon	\$121,005,550
Aggregate cost, with interest thereon . .	\$210,093,502		
Revenues rec'd, with interest thereon . .	202,619,510		
Apparent excess of cost	\$ 7,473,992		

It was further shown that the Erie and Champlain canals had a credit balance of \$38,455,560 upon this basis, and that the others produced a debit balance of \$45,965,940.

The "plant" of the system had thus cost actually less than \$65,000,000; but the railways of the State had, up to 1850, invested in construction and equipment fully \$60,000,000; by 1860 this sum had been doubled; by 1870 practically quadrupled. The canals had for some years been receiving annually less than \$1,000,000 for construction and repairs, whereas the railways were adopting every means offered to increase their efficiency, to enlarge their hauling capacity, to reduce the cost of the service. Thus real competition soon became out of the question.

THE CANAL SYSTEM OF NEW YORK

1867-1909

THE blindness to their own interests on the part of the people, by neglecting the canals, was due chiefly to the lack of adequate leadership among the public men; the railway interests were doubtless influential in preventing the State from keeping the canals in a proper state of efficiency. This apathetic condition continued, and nothing of real consequence was done until after the beginning of the twentieth century; only ineffectual attempts to provide remedies were made in the interval.

Yet there are some matters worthy of record occurring during the decade from 1868 to 1877. The contract system of doing the canal work was thoroughly overhauled; a legislative committee in 1867 confirmed the general belief that the operations of the "canal ring" had caused great waste; a canal convention in 1870 denounced the practices under the system in no uncer-

tain language, demanding the prosecution of all persons who had fraudulently obtained public money thereunder. But there prevailed an era of general extravagance and plundering of the State treasury; and the ringleaders were so firmly intrenched in power that they defied all ordinary attacks. The notorious Tweed was one of the chief characters in the lower ranks of the new Albany Regency; Governor Hoffman did not escape censure for his inability or unwillingness to break the ring. Under his successor, Governor Dix, some efforts were made in that direction; a State commission was appointed to suggest remedies, and some prosecutions were begun; but it was left to Samuel J. Tilden, who became Governor in 1875, to put the wheels in motion energetically. He had investigated and thoroughly mastered existing conditions, and devoted his great ability and all the influence of his office to uprooting the evils and safeguarding the future. Many officials lost their positions, many were pilloried before the public judgment and suffered lasting disgrace; but few criminals were convicted, and none of the public money diverted was recovered, so wide were the ramifica-

tions of the "ring," and so great its power. To illustrate the extravagance, the record showed, for the five years ending 1874, an expenditure for operation and maintenance of the canals, exclusive of "extra repairs," of \$9,202,000 out of \$15,058,000 receipts—or more than 61 per cent.

In 1874, coincidentally with Tilden's election, the people adopted a constitutional amendment prohibiting the use of sinking funds for any other purposes than those of extinguishing the debts (they had been trenched upon by the extravagance); claims against the State were to be barred by limitation, just as ordinary claims are. The purpose was to more closely scrutinize the entire canal business.

In the government of New York City, as well as in various departments of the State Government, boards and commissions had been tried with unsatisfactory results. The people came to believe that in order to concentrate responsibility, it is necessary to concentrate power. Divided responsibility permitted derelict public officials to escape punishment, and the policy of placing departments under the control of a single responsible head was inaugurated. Ac-

cordingly, in 1876, another constitutional amendment provided for a Superintendent of Public Works in the place of the "contract board" and canal commissioners. This officer was charged with the supervision of navigation and repairs, and was a member of the Canal Board. In order to make it more impressive, apparently, the prohibition against sales of the canal property was repeated in the amendment. It was, however, deemed judicious to abandon some of the canals which had proved too expensive; after 1878 the only ones operated were the Erie, Champlain, Oswego, Cayuga and Seneca, and Black River. Notwithstanding untoward conditions, the business of the canals for the decade 1868-1877 proved the largest in their history, freight carried having aggregated 57,700,000 tons, valued at \$2,032,000,000, showing a decline in average values. Of this fully 31,200,000 tons, of the value of \$1,047,000,000, was downward tide-water freight. But the railways carried over 104,000,000 tons during the period, showing that relatively the canals were losing ground. Tolls had again been lowered after the financial crisis of 1873, and hence aggregated only \$26,200,000,

an average of 44.5¢ per ton; freight rates were well maintained, the average per ton being 86¢ and the total paid \$50,200,000; the down-freight rate (Buffalo to Albany) fell as low as \$1.52 at the end of the period, and up-freight was only 3¢ per ton higher. The result of the railway competition in the latter half of the decade placed their ton mileage far ahead of that of the canals, so that for the period the figures were 19,576,000,000 ton miles for the New York Central and Erie lines, against 13,680,000,000 for water lines, a ratio of 58.8 per cent for the railways, compared with 33.8 per cent in the previous decade. A number of devices to increase facilities on the canals were experimented with at this time, particularly steam towage, but without practical results.

The decline of the canal business actually began in 1874 and despite the lowering of tolls. The record year for tonnage was 1872, when 6,673,570 tons were moved; the record year for values was 1868, when a total of \$305,301,920 was reached.

A movement was now inaugurated to abolish all tolls, and so popular did it prove that the

legislature submitted a constitutional amendment for this purpose to the people in November, 1882. It was adopted by a vote of 486,106 against 163,151. This measure provided that the expenses of operation and maintenance be borne by the general revenues of the State, and authorized borrowing to cover deficiencies.

When tolls were abolished and the maintenance of the New York canal system was made a charge upon the taxpayers, the natural impulse toward economy on the part of all, plus the selfish but shortsighted policy of opposition on the part of localities not adjacent to the canals, reënforced by the opposition from competing railways ably and shrewdly manifested by railway managers, rendered the future of the canals most precarious. Their proper maintenance was jeopardized by meagre appropriations and all enlargement of capacity rendered impossible save by constitutional amendment. An object lesson was required to teach the public that the canals, in their then condition, hedged in and crippled by restrictive constitutional provisions, must inevitably sink into decay; that they could not compete with the railways and serve the

commercial interests of the State unless they kept abreast of the times, enlarged their capacity, and adopted modern improvements, the same as their competitors were doing. Experiences following 1882 led many good friends of the canals to question the wisdom of abolishing tolls.

There was at this time substantially no State debt excepting the canal bonds amounting to about \$9,000,000. The financial results of the entire system to the end of 1882 were as follows:

Total revenues of canals.....	\$135,418,325
Expense of operation and maintenance.....	48,399,287
Net revenues.....	\$ 87,019,038
Cost of construction and improvement.....	78,685,580
Profit without considering interest.....	\$ 8,333,458

But the loss on the canals that had been abandoned was over \$18,600,000, so that the existing system had to its credit a gain of nearly \$27,000,000. The interest payments, of course, largely overbalanced this profit; about \$48,000,000 of the cost of the "plant" had been borrowed; the rest came from the canal and general revenues. The canals had paid back to the general funds \$18,850,000; but the Erie had paid the State \$42,599,718 more than the face of its

cost, and, in fact, a large surplus above the cost with interest on the debt incurred.

The canals had carried nearly 200,000,000 tons of freight in the 60 years of their operation; the value thereof was \$8,326,000,000. Contrast this with the modest prediction of the canal commissioners in 1812, that the system might develop a trade of 250,000 tons a year! Freights brought to the boat owners \$182,500,000, thus making a total of tolls and freight of nearly \$318,000,000. These figures represent only a fraction of the benefits derived. The State grew enormously in wealth as well as in population; in 1817 the assessed valuation was \$299,000,000; it had more than doubled by 1837; again doubled by 1853, when the returns showed \$1,266,000,000. This was again doubled by 1876, and in 1882 the amount stood at \$2,800,000,000, of which the "canal counties" returned over 75 per cent. The greater part of the early growth and much of the later was unquestionably due to the existence of the canals.

Abolition of tolls did not check the falling off of business; during the five years ending 1882, the average annual tonnage was 5,500,000, valued

at \$205,000,000, of which 3,400,000 tons was downward tidewater freight, valued at \$92,000,000. In the decade following 1882, the average fell to slightly over 5,000,000 tons, valued at \$146,000,000. The quantity of freight carried down to New York City averaged 2,800,000 tons, the value thereof \$64,000,000; the two principal competing railways were carrying an average of over 34,000,000 tons annually, and other lines were taking more than the canals. That the question of State tolls was not an important factor was conclusively shown. There was an evident desire for a speedier service, notwithstanding the higher cost.

The friends of the canals were not inactive; upon several occasions efforts were made to improve the conditions, notably in the legislative session of 1891, when a plan was formulated. This met with defeat, which brought about a convention of delegates from chambers of commerce and boards of trade in October, 1892, at which the whole question was fully discussed and the legislature addressed in eloquent terms, setting forth the enormous advantage of the waterways to the State, the menace to the com-

merce of the State involved in the continuance of the prevailing policy and the urgency of immediate action. A commission was appointed to consider the subject seriously, and it reported favorably for the improvement, but confining itself to rather narrow lines. After long discussions and much opposition, in no small degree instigated by railway interests, the legislature passed a measure providing for the deepening of the Erie Canal and the Oswego Canal to 9 feet and the Champlain to 7 feet, at an expense estimated at \$9,000,000, to provide which so much as might be necessary was to be borrowed by means of 3 per cent bonds. This work was expected to increase the capacity of canal boats one third. In order, presumably, to protect the boat interests and prevent the canals from falling under the control of the railways, an act was passed in 1896 prohibiting corporations formed to navigate the canals from being capitalized in excess of \$50,000.

The most far-sighted advocates of canal improvement felt that the plan of 1895 was merely trifling with the subject: that it was a "penny-wise and pound-foolish" policy; and so it proved,

Not only was all the money, of which \$8,500,000 was borrowed, spent without bringing the expected results, but the State had again to experience scandalous practices in the mode of expenditures. It may be said, however, for the sake of the canals, "It's an ill wind that blows no one good;" the denouement of this failure served to fix public attention more generally upon the value of the waterways, and more of the citizens of the State gave it intelligent consideration. Successive commissions of experts were appointed, elaborate surveys made, and most elaborate and complete data obtained. Various plans were earnestly advocated, and finally a plan of enlargement, estimated to cost \$101,000,000, which would enable 1,000-ton vessels to navigate the Erie, and materially enlarge the Champlain, was brought forward. Not so long ago such a sum would have staggered the legislature and the people, but when the question was submitted to the latter in November, 1903, it was approved by a vote of 673,010 against 427,698. This contemplates the enlargement of the prism of the Erie from 70 feet to 122 feet at surface and of the depth to 12 feet instead of

9; accommodating boats 150 feet long instead of 98 feet, with draught of 10 feet in place of $7\frac{1}{2}$ feet, thus more than trebling the present carrying capacity.

Since 1892 the average annual tonnage of the canals has been 3,600,000, an annual average loss of 1,400,000 tons compared with the preceding decade. A slight improvement was shown in 1906 over previous years, due to the enormous increase in traffic generally. It is estimated that the average freight rate per ton does not exceed 60¢, making total freight earnings per year \$2,100,000 as against \$7,679,000 in 1871. The railways reaching New York and competing with the canals now carry 70,000,000 tons annually; the canals carry less than 5 per cent of that tonnage, the canal tonnage being in 1913 only 2,602,035 tons.

Several years must pass before the improvements now under way are complete and the wisdom of the same tested by actual experience. There can be no rational doubt of the necessity of modernizing the canals and bringing their capacity up to present commercial needs. It is incontestable that the Erie Canal has proved

most beneficial in the past. In length it is second only to the Great Canal of China, among the artificial commercial waterways of the world. For a quarter of a century it was the greatest transportation line in the country, and this was during the country's first industrial and commercial growth, the most important in this respect, since the country had not yet attained financial strength. Its benefits were not confined to the people of the State; they extended on the one hand to the people of the west country, giving them an outlet for their products and stimulating their development and prosperity; it gave the people of the east, and notably to New England, and also to Europe, cheaper transportation, which meant lower prices to the consumer, particularly of food products. It not only furnished cheap transportation, but compelled the railroads to transport goods at reasonable rates.

The all-rail rate from Chicago to New York is the base line upon which all railroad rates east of the Mississippi and north of the Ohio are fixed, and to which they are proportioned.* The

* Testimony of Albert Finck before the Hepburn Committee.

all-rail rate from Chicago to New York has been steadily lowered to meet the water rate (by lakes, canal and river) from Chicago to New York. In this way the Erie Canal has been the regulator of railway rates, and has cheapened freights to all people of the State and directly benefited them, whether they reside in the canal counties, or in the southern tier, or in the St. Lawrence valley. For instance, the all-rail rate in 1868 upon wheat, Chicago to New York, was 42.6¢ per bushel; in 1879 it was 20¢, and in late years it has averaged under 11¢. Carried by lake steamer to Buffalo and by canal and river to New York, the rate was 23¢ in 1868, 12¢ in 1879, and has been 5¢ in recent years.

We have noted the enormous revenues which the Erie Canal paid into the State treasury. More important still, it was the chief, if not indispensable, factor in building up a chain of towns and cities along the routes, which make the State first in population, and also in fostering the rapid development of wealth, placing the State in the lead in that respect among the commonwealths of the Union. It was the channel

through which were poured the raw products of the west into the archives of New York; and in turn finished products were carried to western consumers, until New York City, during the period 1868-1872, enjoyed 56 per cent of the total export trade of the whole country; it now enjoys less than 35 per cent.

In 1820 the population of the State was 1,373,000; its assessed valuation was \$256,000,000. The present population is nearly 10,000,000, and the assessed valuation is about \$12,000,000,000. The State can much better afford to spend \$101,000,000 upon the canal now than it could \$10,000,000 in 1820. While conditions are not in the least similar, the State's necessity is quite as great.

The history of the canals bears upon the question, recently much discussed, of public ownership and control of transportation facilities. Here was a great and beneficent public work, undertaken for the advantage of all the people, to provide cheaper transfers; side by side another form of transportation was developed under private auspices. While the latter was year by year improved to meet the evergrowing needs, the

former was permitted to degenerate. Doubtless the railway interests assisted in making the canal record a deplorable one, but this fact merely adds emphasis to the opposition to public ownership. It is safe to say that had the canal system been privately owned by strong interests, it would not have degenerated as it did. Public service, unless under continuous stimulation, does not yet seem equal to the task imposed by such undertakings. Much remains to be done in the way of public service reform before the change to public ownership and operation can be regarded wise.

The canals of New York were necessarily built by the State. The undertaking called for too vast an expenditure to be within the means of individual or corporate enterprise, owing to the comparative poverty of our newly formed commonwealth and its undeveloped resources. Nevertheless, it is the most important instance of government ownership of a public utility that we have. It is owned and managed by the State upon the general principle upon which municipal and government ownership advocates claim that all public utilities should be owned and controlled,—in order to furnish the public

good service, freed from the control and manipulation of the avaricious.

Recall its infinite delays, extravagance and graft; recall its most unbusinesslike management; no improvement in capacity for the past 47 years, notwithstanding it has been a period of phenomenal development and prosperity; and contrast its management with that of its rivals, the railroads, as to roadbed (prism), rolling stock (boats), general equipment, general management; and surely it must all militate against the wisdom and efficiency of government ownership and control in all cases where individual enterprise may supply the need. The same reflection compels the conclusion that the present plans for improvement and development, expensive though they be, are amply justified, and that the canals should in future be managed with the solicitude and business acumen which characterize individual enterprise.

With proper supervision of the enormous expenditure proposed, with an effective control of the management to the end that the enlarged canal shall furnish the service contemplated and, with wise economy in the place of careless

extravagance, it appears entirely safe to predict that the State will receive, in increased trade, profits of the transport lines and general growth of the municipalities along the line of operation, a return which will be proportionately as great as that which the records of the Erie show to have been realized in the past and that in the not distant future the benefits will have more than offset the entire expenditure.

In addition, great pecuniary advantage will accrue to the producers and the consumers, not only along the line of the canal, but throughout the entire State, from the great reduction in the transport charges that must inevitably follow the enlargement.

THE CANAL SYSTEM OF NEW YORK

THE COMPETITION AGAINST NEW YORK CITY

THE importance of the Erie Canal during the period of its greatest efficiency, to the commercial and industrial development of the State of New York, cannot be overestimated; it was all-powerful in making the City of New York the chief port of the United States and one of the greatest ports of the world.

(See Appendix. Tables 14 and 15.)

In 1880, the total exports of the United States were \$835,638,758; New York City's proportion of this was 46.9 per cent. In 1890 the total exports of the United States were \$857,828,684; the amount exported through the Port of New York was 40.6 per cent. In 1900, New York's percentage had fallen to 37.2. In 1913, the total exports of the United States amounted to \$2,465,884,149, \$917,935,988 of which found its way abroad through the Port of New York, it being 37.2 per cent of the total amount.

With the growth and development of the

country, it is inevitable that New York's relative percentage of exports and imports should decrease, and that although the gross amount may increase from year to year, this apparent loss in New York's share should accrue to the advantage of other ports. The point that should be impressed upon the minds of those who are responsible for New York's commercial welfare is that New York's percentage of loss has been much greater than it would have been had an enlightened and progressive policy with reference to her internal navigation kept her canals and rivers abreast of the times and in condition to meet the growing volume of trade.

A number of factors have combined to reduce the percentage of New York's export trade; unlike many of her rivals, she has no railroad interests specially devoted to her cause in the struggle for traffic. The New York Central Railroad, through its control of lines to Boston, derives just as much, if not more, advantage in carrying freight to the New England port; the other trunk lines entering from the south stop at, or pass through, rival seaboard terminals before reaching New York.

A complex system of "differentials" in through rates by rail from interior points to the seaboard discriminates against New York. The purpose of this system is to place all Atlantic seaboard points upon an equality, by off-setting in transportation charges the assumed advantages possessed by New York, both in the matter of easier transportation, due to better gradients of her railways through the Mohawk Valley, and the somewhat lower ocean freights due to the greater competition among foreign carriers who, lured by the volume of trade, came to New York in greater numbers. Thus by agreement between the trunk lines, Boston, although 50 miles farther from Chicago, by the shortest route, obtains the same rate as New York. Philadelphia, Baltimore, and Newport News, all nearer the west than New York, were accorded lower rates by reason of the shorter haul. Recent alterations in the schedule have reduced the differentials somewhat, but the ports to the south have still a substantial advantage in respect to rates.

On the other hand, New York's insular position compels the imposition of lighterage charges for the transshipment of freight from railway

cars to ocean steamers; competing ports avoid this charge, because freight is transferred from terminal tracks direct to the ocean carriers. A further impost is laid upon New York's foreign trade by her very high port charges, explained, perhaps, but by no means justified, by her very inadequate dock facilities. The crowded condition of the wharves and the channels of ingress and egress therefrom, and the narrow thoroughfares occupied so fully by other interests, necessarily impede traffic and render the same more expensive.

But the deterioration of the canal service, or, more properly speaking, the failure to maintain and develop it, to keep pace with the advancing needs of trade, are mainly responsible for the very large relative falling off of New York's foreign trade, especially as to exports. The enormous export grain traffic coming through the Great Lakes demands cheaper handling than the present means available to New York afford. Transshipment from lake steamers at Buffalo, and forwarding by rail to the metropolis, involves a charge of 5¢ per bushel. By canal the charge is substantially the same. The Canadian

route, *via* the Welland Canal, Lake Ontario, and the now efficiently canalized St. Lawrence River, affords a transfer at so much lower rates, that the estimated cost of conveying a bushel of grain from Duluth, or other primary lake points, to Montreal, where transatlantic steamers take the cargo, is only 5¢.

Freight has no consideration of patriotism; obedient to imperious economic law, it will move along the line of least expense. The St. Lawrence route, completed, as to the latest improvements, in 1900, is now by far the shortest and cheapest, and Montreal and the Dominion are profiting from the large but judicious outlays of public money upon this waterway. Unless the rivalry is adequately met, it is only a question of time when the bulk of the enormous trade of the rapidly developing northwest, will reach the markets of the world through the Dominion route, whether originating in the Dominion or in the United States.

The freight which passes through the two canals (American and Canadian) at Sault Ste. Marie, reached an aggregate of over 79,000,000 tons in 1913, an increase of over 26,000,000 tons

in two years. The capacity of the vessels engaged in lake traffic and utilizing these canals has been enlarged almost annually. To meet these developments the Canadian government improved its great waterway to the seaboard, so as to admit the passage of vessels of 2,200 tons burthen. The capacity of the locks of the Canadian canals is more than twice that of the locks of the Erie. Canada is thus able to take advantage of the fact that the route from Chicago or Duluth to Liverpool, *via* Montreal, is 450 miles shorter than *via* New York. Following this expenditure of many millions, further improvements are now contemplated in order to enlarge the facilities and diminish the obstacles and expense still more. For a decade past, another and still shorter route has been under consideration from Georgian Bay to Montreal *via* the Ottawa River.

The Montreal, Ottawa and Georgian Bay Canal is still a project, but it has behind it, apparently, the settled policy of the Canadian government and will rank with the Panama and Barge Canal works in magnitude. The canal as recommended by the engineers, would be 440

miles long, extending from Montreal to Georgian Bay, overcoming by 27 locks a summit level of 659 feet and requiring also the building of 18 main dams. It will have a bottom width of 200 feet and a standard depth of 24 feet. It would make a waterway for vessels 600 feet long, 60 feet beam and 20 feet draught. The route includes fully 400 miles of sheltered lake and river, susceptible of economical improvement. Of the 40 miles of actual canal required, nearly one-half, in the vicinity of Montreal, already exists but would, of course, require deepening and enlargement. This route will save approximately 340 miles of navigation as compared with the route *via* the Lakes and St. Lawrence River, and will make the distance from Chicago or Duluth to Liverpool, *via* the proposed canal, approximately 800 miles shorter than *via* New York.

The Chicago Harbor Commission, in its report of 1909, said of the Georgian Bay project:

“This scheme is of the greatest significance to Chicago, for it would give Chicago practically a great circle route to Liverpool and other ports of northeast Europe, saving 774 miles over the present journey by way of New York.”

These are the competitive factors which New York proposes to meet by the enlargement of the Erie canal; it is the sole remaining resource. Only recently a number of large freighters of transatlantic lines operating from New York were for a time taken off from service; the representatives of the ocean-carrying companies protested to the railway companies against their scale of charges upon grain, which they assert make the transportation cost to Europe *via* New York prohibitive, as compared with the Montreal route. But the railways have troubles of their own, and are struggling with serious problems which apparently preclude their reducing these charges. The canal is the only means in sight to stay the further decline of the commerce of the Port of New York.

The trunk lines terminating at the seaboard have by agreed differentials bargained away all of New York's natural advantages of gradient. As to such differentials, there is force in the claim that the Pennsylvania Railroad should be allowed to charge less for freight, from the interior to Philadelphia, than they charge for hauling similar freight through Philadelphia on to

New York, an added distance of 90 miles. The differential to Baltimore is based upon similar reasoning, but Boston, 50 miles farther from the interior than New York, is given the same rate as New York. The crucial facts of present experience prove that the railroads cannot maintain the commerce of the United States, in competition with Canadian waterways. It is no longer a question of competition between rail and water—the question is, Can the canalization of our water routes so supplement the railroads that, working together, they can retain for the United States the foreign commerce to which it is normally entitled?

THE CANAL SYSTEM OF NEW YORK

BARGE CANAL IMPROVEMENTS

THE Erie, Oswego, Champlain and Cayuga and Seneca Canals are now being enlarged to a depth of 12 feet, with 57 locks (one of which—a siphon lock—will be the largest of its kind in the world) of a size sufficient for boats having 2,000 to 2,500 tons capacity, as compared with 240 ton boats under present conditions. The State of New York has voted to expend \$128,000,000 on this enlargement, of which \$19,000,000 is designated for providing terminals in and about 50 cites and villages. Construction was begun in 1905.

The State Engineer, John A. Bensel, writing under date of July 28, 1914, says:

“The amount of work placed under contract (June 1, 1914) is, in round numbers, \$85,000,000, and the amount of work performed to June 1st is, in round numbers, \$69,000,000, these figures embracing the work on all the canals of the State exclusive of the construction of the Barge Canal terminals. Payments have been made on

account of all expenses incurred in connection with the Barge Canal Improvements to July 1st, in an amount of \$87,805,000, this figure not including about \$3,000,000 earned by the contractors, but held by the State as retained percentages.

It is difficult to make a deduction from the above figures relative to the percentage of work remaining unfinished, but a general statement of the status of the work is as follows:

In all probability the entire Champlain Canal and that portion of the Erie Canal from Waterford to Three River Point, the junction of the Erie and Oswego canals, and the entire Oswego Canal between this point and Lake Ontario will be completed during the season of 1915, as will also the Cayuga-Seneca Canal improved, and the canal from the point of junction of the Cayuga-Seneca Canal and the Erie Canal to Three River Point, making possible the utilization of the Barge Canal between Lake Ontario and the Cayuga and Seneca lakes.

The opening of the Champlain Canal and the Erie Canal for through traffic *via* Hudson River, will be dependent upon the progress made by the Federal government in constructing their dam and lock in the Hudson River at Troy.

Between Rochester and Tonawanda practically the entire section of the canal has been improved to Barge Canal dimensions, there remaining to be performed between Rochester and the Niagara River but a small amount of work at the Tonawanda entrance, and certain incidental details along this section which would not interfere with its being open for navigation as soon as the connection is made at Tonawanda.

Due to complications encountered between Clyde and



VIEW OF THE NEARLY COMPLETED GIFT LOCK, BASIN CANAL, LITTLE FALLS, ONE OF THE HIGHEST LIFT LOCKS IN THE WORLD, SOHARU RIVER, WEST SHORE KANAWHA AND A PORTION OF THE CITY OF LITTLE FALLS, SHOWING IN THE DISTANCE.

Reproduced by courtesy of Hon. J. A. Bense, State Engineer.

Rochester at points where the line of the canal is crossed by the lines of the different railroads, the Barge Canal work has been materially delayed and it is not possible at this time to state how soon all of these railroad crossings will be disposed of, the courts having only recently made a decision which will act as a guide in their construction.

The Barge Canal between Northumberland northerly to Whitehall is being operated this year in connection with the canal system of the State, this section having been completed in its entirety. There are also several other sections of the canal in addition to the stretch between Rochester and Tonawanda, which are completed to Barge Canal dimensions, but which cannot be utilized at this time by reason of the interference with navigation on the present canal, or by reason of adjoining work not being completed, the total length of completed Barge Canal prism being about 350 miles.

In general it may be said that the status of the Barge Canal work is considered very satisfactory and the beginning of the navigation season of 1916 should see the greater portion of the Barge Canal system completed and in readiness for operation."

The State Engineer has kindly given his best estimate of when the canal will be completed. It appears that about 15 per cent of the work is not yet under contract. It is nine years since the work was undertaken, and two or three years more must elapse before the canal will be completed.

One of the strong hopes that inspired the Barge Canal was the expectation of regaining for New York the export grain trade, with the reciprocal business that such trade would naturally bring. The growth of our population has shattered that hope, for it is likely in future that we will consume, at home, practically all the grain we raise. Our enlarged waterway must and will find other means of justifying its existence.

Canals have proven their utility as carriers of freight, and in equal degree have they served the public as competitive regulators of transportation rates by rail. We have already seen that all railroad rates east of the Mississippi River and north of the Ohio are predicated upon the all-water rate from Chicago to New York; thus every shipper east of the Mississippi is served by and indebted to the Erie Canal.

The Barge Canal will fail to move grain to any great extent from Buffalo to the seaboard, but its capacity will be utilized nevertheless. It will have great advantage in moving freight, seeking transportation in large units, especially such as is bulky in character and admits of slower delivery. For illustration, lumber, forest

products, require several months after manufacture in which to season and be ready for use; manifestly, lumber or timber suffers little from slower transportation; also the heavier forms of retail hardware, machines and machinery of standard character, which retailers keep in stock; raw material, cotton, wool, hemp, jute, grain for milling, building materials, cement, brick; no better site for a great steel plant, than the Port of New York, can be conceived, with the ore, coke and coal of the west brought within easy access at very low cost; as a distributing point New York is unsurpassed. This enlarged canal must give an impetus to manufacturing of all kinds along its entire route from New York to Buffalo.

THE CANAL SYSTEM OF NEW YORK

RELATION OF CANAL AND RAILWAYS

I HAVE generally made use of grain rates, in comparing different periods and in comparing water and rail transportation, because they have been differentiated in official reports, and because economic writers have made greater use of the same; of course the same general relation exists with reference to all kinds of freight charges.

The Erie Canal, finished in 1825, gave the greatest impetus to inland transportation, which it had received up to that time, and a boom in the building of canals and the canalization of lakes and rivers ensued. All this ante-dated the existence of railways. As soon as railways came into general use, the decadence in canal and river transportation was very pronounced.

In 1850 the canals of New York carried 81.1 per cent of the traffic handled—23 years later it had fallen to a little less than 35 per cent, and

in 1908 the canals carried less than 4 per cent of the total traffic handled in the State.

As to river transportation, St. Louis is as well situated to avail of this means of transit as any city in the country. The quantity of freight shipped by the Mississippi River, from St. Louis, in 1880, was 1,038,000 tons; 20 years later it was 245,800 tons; in 1911 it was 191,965 tons. In 1871, 44 per cent of St. Louis freight was shipped by the Mississippi River; in 1911 the proportion had fallen to one-half of one per cent. The railways centering in St. Louis make it one of the great reservoirs of trade, and the rails have taken possession of the business.

The reasons why traffic went to the railroads are not far to seek. Among them may be mentioned the fact of greater celerity in transportation, which means quicker delivery and quicker payments; it means a saving of interest, a more rapid turnover of principal, and *per contra*, similar advantage results in the receipt of goods; railroads give service all the year round, whereas the principal canals, lakes and rivers are closed during the winter months; railways are equally available to inland towns, as well as those lo-

cated upon water, both for receiving and delivering freight; the custom of travel and retail trade takes people naturally to railway stations in much greater degree than to water stations; the availability of an everyday supply by rail enables retail dealers to supply their customers with a much smaller but constantly recruited stock of goods; they thus minimize their capital investment; freight by rail is handled with greater ease; switches bring cars to the door of the factory or warehouse; permanent machinery may be provided for loading and unloading. Waterways cannot provide switches, and the ever-varying water level precludes the use of permanent machinery for loading and unloading. The variation of the surface level of the Ohio River at Cincinnati is 60 feet; of the Mississippi, at St. Louis, it is 43.92 feet, and at New Orleans it is 21.02 feet.

In regular course of competition the railroads made discriminatory, all-the-year contracts, thus penalizing those who used canals in summer and rails in winter; such a practice was made unlawful at a comparatively recent period; railroads were privately owned and their growth was

stimulated by all the energy of private enterprise; inventive genius perfected machinery and devices; experience pointed the better methods and gave a constantly improving service to the public; capital in unstinted volume fostered extension of lines and expansion of affiliated and reciprocal interests, which brought and bound traffic to the roads.

On the other hand, inland water transportation, with few exceptions, was government owned or controlled, and suffered the blight that seems to be inseparable from political domination. No self interest prompted brain-racking study to improve method and machinery, to facilitate service and adapt the same to the wants of shippers. Economy, very often false economy, and railway rivalry conspired, frequently, to embarrass, if not cripple, these public channels of trade. The decadence of inland water transportation, in respect to capacity of prism, means of locomotion, size and quality of boat, contrast painfully with the phenomenal development of the railways in all respects.

We have had the usual experience of all new countries lavishly endowed by nature with rich

stores of latent wealth. We have had a saturnalia of waste, in a mad effort to bring all latent resources into market at once. The crime of the age consists in the effort to convert real estate, field and factory, forest and mine, into personal property by the fiction of corporation stocks and bonds, anticipate the future in the amount of capitalization and then sell the same to a hopeful and optimistic public with patriotic confidence in the future of our glorious country. But fortunately the turn has been called, conservation has succeeded wanton waste; with the legislative, the executive and private owner as well, conservation has become the guiding principle. With this change from hectic haste to a sobered and sagacious business policy, from mad exploitation to wise utility, will come a growing use for canals and rivers; deliberate economy in preserving nature's resources will make use of nature's improved and corrected means of transportation.

The Barge Canal will move freight in summer, and warehouse it in winter in the harbor of New York, in fleets of barges, the same as the old canal has done in the past, but on a grander scale.

The New Barge Canal will have a greatly enlarged capacity over the present canals, which reached their highest efficiency in 1872, when 6,673,370 tons were moved, and which in 1913 carried only 2,602,035 tons. The Barge Canal Terminal Commission in its report of 1911, estimated that the Barge Canal would carry 10,000,000 tons soon after completion and that this amount could be increased to 20,000,000 tons.

The Commission reported that the average cost of carrying freight upon the railroads of New York is .445 of a cent per ton per mile, and as the distance by rail from Buffalo to New York (New York Central) is 440 miles, the cost of a ton of freight is \$1.96, the rate charged being \$3.11. The Commission estimates that the cost to carry the same freight from Buffalo to New York by Barge Canal and river will be only 26 cents. If this assumption is right, the canal will soon pay for itself as an economic proposition, provided the other costs of transportation, such as terminal charges, expenses of transshipment, etc., do not equalize the difference.

The new Barge Canal, unlike the old canals,

which it will displace, is largely a river canalization scheme, following mostly natural water courses. There are 440 miles of construction in the new canal project, which, with 350 miles of intervening lakes and rivers make a system for the four canals under enlargement, of 790 miles. It is computed that $73\frac{1}{2}$ per cent of the State's population is within two miles of this waterway system.

THE PANAMA CANAL

No discussion of the influence of artificial waterways upon the economic future of the world would be complete without description of the gigantic undertaking of the government of the United States to complete the abandoned French enterprise of connecting the Atlantic and Pacific oceans at the Isthmus of Panama.

The advantage of such a canal was clearly perceived as early as 1520, when Charles V of Spain is reported to have given it consideration. In 1534 a survey was ordered, but unfavorable reports of the Spanish governor of Panama, and probably also his suggestion that such a work would be in "opposition to the will of the Almighty, who had placed this barrier in the way of navigation between the two oceans," caused the project to be abandoned;¹ although the project was revived at later periods, it never took practical form until about 1878, when French in-

¹ The medieval religious fervor that dominated the action of Spain in all things, seems ludicrous in the light of present day advancement.

terests obtained a concession from the republic of Columbia. De Lesseps, who had built the Suez Canal, was the chief spirit in the enterprise undertaken by a French corporation formed in 1879.

Improvident expenditure of money, manipulation of the company's stock in the interest of stock-jobbing ventures, graft, which was alleged to implicate those high in authority, technical errors and faulty management generally, brought the company to bankruptcy in six years. De Lesseps struggled manfully to advance the work; he unwisely submitted to blackmail and countenanced actions that he should have resisted to the utmost, thereby clouding a glorious reputation, in order to consummate the enterprise, all of which, however, simply hastened its failure.

Actual operations were delayed until 1883; then the concession expired, and it was only after much delay that a renewal was obtained, under which a new company was organized in 1894. The plans of this corporation also proved unsuccessful, and work was practically abandoned. The concession was for ten years, thus expiring in 1904; another grant from Colombia

was obtained, with a condition that the canal should be completed by 1910.

Private interests in the United States had obtained a concession for an inter-oceanic canal traversing Nicaragua. If a lock canal was to be built the Nicaragua route was generally believed to be the best—a sea-level canal over that route was impossible. Much money was raised and expended upon this route, but it was easily apparent that the enterprise was too great for private capital. In June, 1902, Congress passed an act, under which the government was to undertake the construction of an isthmian waterway. In order to prevent the possibility of having two canals, it was decided to adopt the Panama route, provided the French interests could be acquired and the work they had done thus be utilized and at the same time a satisfactory treaty could be made with the government of Colombia. President Roosevelt negotiated a treaty with the Colombian government. I quote Mr. Roosevelt's words:

“The then Colombian government was embodied in the person of a single man, a dictator, with absolute executive and legislative powers. He had been elected

vice president, and after a short time seized the president and put him in jail. He then published an edict, saying that under the constitution, for he was an ardent adherent to the letter of the constitution, it was his right to assume all executive powers in the absence of the president. He refused to permit Congress to assemble. He then published another edict, reciting that under the constitution it was his right to assume all the legislative powers in the absence of Congress. The absence of the president soon became permanent, as he died in jail. Year after year went by, and still no Congress was allowed to meet," etc., etc.

With this Colombian government a treaty was made, acquiring the right to build and own the canal, with a canal zone extending 5 miles on either side of the canal. Colombia was to receive \$10,000,000, and after nine years an annual stipend of \$250,000. For the rights and property of the French company the United States paid \$40,000,000; this included the Panama Railway, which the French company had acquired and owned. The United States had abandoned their negotiations with Nicaragua, had entered into this Colombian treaty and had agreed upon terms for the purchase of the French interests. At this juncture, the president of Colombia convened his Congress, had them reject the treaty

and adjourn, thereby thinking to place himself in position to negotiate a better trade with the United States. It seemed that the fate of the canal was again subject to the interminable delays that characterize the action of Central American governments.

The State of Panama, which naturally was most interested in the canal, concluded to secede from the federal Republic of Colombia, and take matters in its own hands.

This happened in November, 1903. The new government was immediately recognized by the United States, and a similar treaty negotiated with Panama, to the one made with Colombia. For the exclusive ownership and control of a strip of territory of five miles on each side of the proposed canal, the new republic of Panama received \$10,000,000. (After nine years there is also to be paid an annual stipend of \$250,000.)

The United States entered into immediate possession of the canal zone, and any attempt to suppress the secession of Panama by Colombia would have brought Colombian troops in direct conflict with United States blue jackets. Of course no attempt was made. The very prompt,

not to say summary, action of our government, has been much criticised. Had the government of Colombia been a representative one, and the treaty been rejected in due course of prescribed action, for reasons of disagreement, such criticism would possess great force, but the man who possessed absolute power in Colombia made the treaty and procured its rejection, in order as Mr. Roosevelt charges and as seems most probable, to enable him to drive a better bargain, or as some surmise, to enable him to confiscate the French claims and realize whatever value they might possess. The world wanted the canal; the United States was ready to build it, and to have this great enterprise frustrated by the petty bickerings of this self-constituted dictator, was intolerable. The conscience of the world and the verdict of history will not only justify but applaud the action of our government in the course it pursued.

After much discussion and consultation with leading engineers, not only from our own country, but from Europe as well, it was decided to abandon the sea-level canal, for which the De Lesseps company was working, and adopt a lock

canal. The engineers were divided as to the relative feasibility and desirability of a sea-level or lock canal, but all agreed that the lock canal would be much cheaper. The engineer's estimates of total cost varied from \$140,000,000 to \$200,000,000; the fact that the larger estimate was nearly doubled shows how unreliable estimates of cost of such a gigantic and unprecedented work must necessarily be.

The following succinct data will be of interest:

Built and owned by the United States. Ship canal. Lock type. Connects Caribbean Sea with the Pacific Ocean.

Summit elevation (about).....	85 feet
Length from deep water to deep water.....	50 miles
Length from shore line to shore line.....	40 miles
Bottom width.....	300 to 1,000 feet
Minimum depth.....	41 feet
Locks in pairs.....	12 feet
Gatun Lake area.....	164 sq. miles
Gatun Dam $1\frac{1}{2}$ miles long, nearly $\frac{1}{2}$ mile wide at its base, with crest elevation of 105 feet above the sea.	
Culebra Cut, channel depth.....	45 feet
Excavation, canal proper.....	209,668,000 cubic yards
Excavation, permanent structures, including terminals.....	22,685,000' cubic yards
Excavation by French company, useful to present canal.....	
Concrete for canal.....	5,208,000 cubic yards
Time for transit through canal.....	10 to 12 hours
Canal Zone area.....	436 sq. miles

Total force at work on canal and railroad in September, 1913 37,000
 There are 22 angles with total curvature of 600° 1'
 Ships in passing through the canal are towed by electric locomotives operating on tracks on the lock walls.

Work was begun by the United States on May 4, 1904, and ships of not over 30 feet draught passed through the canal in 1914; official opening in March, 1915.

The canal cost to the United States is \$375,000,000, including \$40,000,000 paid to the French company for its rights and properties and \$10,000,000 to Panama; \$20,053,000 the expense of sanitation and \$7,382,000 paid for civil administration. Interest on this sum will be \$11,250,000 annually, the operating and maintenance expenses are estimated at \$3,500,000; \$500,000 will be required for sanitation and government, and \$250,000 is to be paid yearly to the Republic of Panama. These sums, with amortization fund, will make the annual expense \$19,250,000. The total expenditures of the Suez Canal in 1913 amounted to 45,981,079 francs, or about \$9,200,000. The estimated Panama Canal traffic in 1915 is 10,500,000 tons net

register of shipping, and it is estimated that this will increase to 17,000,000 tons by 1925. Under the Panama Canal Act, approved August 24, 1912, the tolls on the canal will be \$1.20 per net vessel ton; vessels in ballast without passengers or cargo paying 40 per cent less. Naval vessels pay 50 cents per displacement ton; and naval transports, colliers, hospital and supply ships, \$1.20 per net ton. The provision of the Act exempting American coastwise ships from paying tolls was repealed in 1914.

The Canal was opened to commerce August 15, 1914. (See Appendix, Table 16, distances saved by the Panama Canal.) The depth of the Panama Canal is 41 feet; Suez, 32.9 feet (with depth of 36.1 feet planned); Kiel, 36 feet; Manchester, 28 feet; Amsterdam, 32.1 feet; Cape Cod, 25 feet; Ambrose Channel (N. Y.) 40 feet.

The facilities of the Canal will bring the territory of the United States east of the Mississippi River in touch with the teeming peoples of Asia, numbering fully 750 million souls, not to speak of the rapidly growing Australasian commonwealths and the islands of the sea.

The Pacific ports of the United States will be

nearer to the Atlantic ports, comparing the all-water route *via* Cape Horn, by nearly 8,000 miles; and those of Chili, Peru, etc., will be brought nearer New York by from 4,000 to 6,000 miles. Yokohama and Shanghai, Manila and Sidney, will be also from 4,000 to 8,000 miles nearer. The proximity of the Gulf ports promises to afford the Southern States of the Union a great opportunity for industrial and commercial development.

The cotton and cereals going to Japan and China will be delivered at less cost, and the demand for these commodities will naturally expand. The use of the Mississippi and its tributaries will be almost certainly revived, and the Father of Waters may recover its former commercial importance.

Nor will the advantage accrue entirely to the United States; for although the difference in distance between the ports of western Europe and the Orient, *via* Suez and *via* Panama, is not substantially important, that between those ports and the Pacific ports of both North and South America and points in Oceanica will be materially shortened by the Panama waterway.

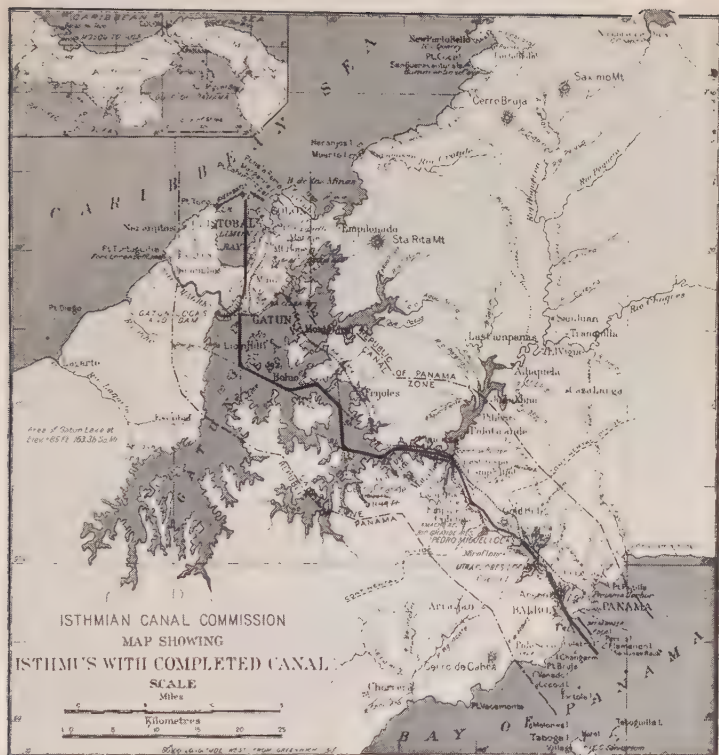
Moreover, by a competitive toll rate *via* Panama, a considerable part of the Asiatic traffic will doubtless be diverted from Suez.

While the Panama waterway is to be neutral, that is, open to all nations, it is patent that its control by the United States is of almost incalculable importance in the event of war. The experience during the Spanish War, and the more recent experimental test of sending a full fleet around the Horn, are circumstances which clearly show the strategic importance of the short waterway.

Without the Panama Canal the United States, in the proper defense of its coast line, as well as the enforcement of its rights and protection of its commerce, would be compelled to maintain two first-class navies—one in the Atlantic and one in the Pacific—since, in the event of war, months must elapse ere war vessels on either coast could be made available on the other. The lessened cost of naval expenditure, apart from the advantage to commerce, will therefore fully justify the expenditure in building the canal by the United States.

The canal is now in operation; it is idle to

speculate upon its future; regular reports will give us facts which are far better than estimates. It opens with all Europe involved in war and the trade of the world prostrate, which must for a time prevent a normal tonnage, and retard its commercial use, but peace will regain its sway, and the abundant use of this most important canal fully justify its construction.



PANAMA CANAL ZONE.

OTHER GREAT AMERICAN CANALS

AMBROSE CHANNEL—NEW YORK HARBOR

THIS is practically a great ship canal through the Harbor of New York, permitting entry to the largest ocean vessels from the sea to the North River docks. But it is a canal without banks, the waters of the channel mingling with the waters of the Bay without surface demarcation. The Channel has a depth of 40 feet at mean low water for 1,000 feet width over the inner half and 1,750 to 1,900 feet over the outer half. It is easily navigable at mean low water for ships of 37 feet draught going at moderate speed and has a maximum high water capacity of 44 feet. These dimensions, and its constant use, make it one of the most important waterways in the world.

CAPE COD CANAL

It was opened July 29, 1914, built by private capital, financed by August Belmont, and con-

nects Buzzard's Bay with Barnstable Bay, thus obviating the passage around Cape Cod. It is 13 miles long, of which 8 miles is the cut through the land, five miles constituting the approaches or channels dug in the waters of the United States. The depth of the land cut is 25 feet at low water; it is 100 feet wide at bottom and 300 to 400 feet wide at the surface. The channel approaches are 200 to 300 feet wide. The cost was \$12,000,000. The canal shortens by 70 miles the present route around Cape Cod and avoids its dangerous fogs. The canal is large enough to accommodate all craft up to 23 feet draught, and is capable of enlargement so as to receive the largest men-of-war. It is estimated that the registered tonnage that has rounded the Cape is 25,000,000 tons a year. There are 7,000,000 tons of coal and lumber carried by tows and sailing craft, and 4,500,000 tons of coal and lumber carried by steamers. It is expected that the canal will obtain this traffic, which will make it one of the most important waterways in the world.

Nineteen fourteen is the banner year in canal construction. The Cape Cod Canal and the

Panama Canal, opened in July and August respectively, are an unprecedented contribution to the transportation facilities of the world.

SAULT STE. MARIE CANALS

There are two canals for the passage of vessels around the rapids of St. Mary's River, one owned by the Canadian government (described under the head of Canadian Canals) and the other by the United States. The American canal is 2.7 miles in length, 25 feet deep, has three locks and cost \$13,000,000. It was first opened to navigation in 1855.

In 1913 the freight carried through the Canadian Canal amounted to 42,699,324 tons, and through the American Canal to 37,022,201 tons. The two canals, however, should be treated as one as regards traffic; and their combined freight carried in 1913 amounted to three times that passing through the Suez Canal, although the latter is open the whole year while navigation in these American canals is only for eight months. The total Sault Ste. Marie freight tonnage in 1913 was 79,718,344 tons, an increase since 1904 of 48,172,238 tons. The traffic has there-

fore more than doubled in ten years. In 1913, 95 per cent of this traffic was carried by steamers. The value of the freight transported in that year amounted to the enormous sum of \$865,957,838.

The following is a statement of the total freight carried (short tons) in the past ten years:

1913	79,721,525
1912	72,472,676
1911	53,477,216
1910	62,363,218
1909	57,895,149
1908	41,390,557
1907	58,217,214
1906	51,751,080
1905	44,270,680
1904	31,546,106

The character of the traffic is shown by the following main items:

	1913	1912
Coal, tons.....	18,625,558	14,937,836
Flour, bbls.....	10,203,462	8,652,431
Wheat, bu.....	204,446,661	173,934,451
Manfd. and pig iron, tons.....	431,777	698,247
Salt, bbls.....	735,376	648,616
Copper, tons.....	106,994	126,854
Iron ore, tons.....	48,091,821	46,310,284

The constantly growing tonnage of American vessels engaged in commerce on the Great Lakes, amounted in 1913 to 2,939,786 gross tons.

CANADIAN CANALS

There are ten Canadian canals having a total tonnage in 1913 of 52,053,913. Of this amount nearly 82 per cent represented the traffic of the Sault Ste. Marie Canal, 6 per cent that of the Welland Canal, and 8 per cent that of the St. Lawrence Canal. Nearly 97 per cent of the total traffic was therefore in these three canals.

The capital cost of the Canadian Canals up to March 30, 1913, was \$105,656,037. The St. Lawrence River, with the system of canals above Montreal, and the lakes Ontario, Erie, St. Clair, Huron and Superior, with their connecting canals make a water communication from the straits of Belle Isle, at the mouth of the St. Lawrence, to Port Arthur, a distance of 2,217 statute miles, the difference in level, about 600 feet, being overcome by 48 locks.

The Dominion government is now constructing a new Welland Canal, connecting lakes Erie and Ontario, to cost \$50,000,000, and this will have a depth of 25 feet in the stretches and of 30 feet in the lock sills. It is being con-

structed to enable the large lake vessels from Lake Erie to reach Lake Ontario points; and the project is mooted of so canalizing the St. Lawrence that these vessels could proceed directly to Montreal and Quebec.

The Canadian Sault Ste. Marie Canal was begun in 1888 and completed in 1895. Its length is 7,472 feet, and there is one lock of 900 feet by 60 feet, with a rise of 18 feet. The canal has been constructed through St. Mary's Island, on the north side of the Rapids of St. Mary's River, and in connection with that river gives communication on Canadian territory between lakes Huron and Superior.

The gross traffic of the Canadian canals during the ten years ending December 31, 1913, increased 530 per cent, as is shown by the following table of combined tonnage:

1913	52,053,913
1912	47,587,245
1911	38,030,353
1910	42,990,608
1909	33,720,748
1908	17,502,820
1907	20,543,639
1906	10,523,185
1905	9,371,744
1904	8,256,236

The following table shows the commodities carried through these canals in 1913:

	<i>Tons</i>	<i>Per cent of the whole</i>
Agricultural products.....	8,522,327	16.40
Animal products.....	19,301	.04
Manufactured products.....	1,881,699	3.61
Forest products.....	1,678,925	3.22
Mining products.....	<u>39,951,661</u>	<u>76.73</u>
Total.....	52,053,913	100.00

Of this total 40,923,038 tons were of United States freight, and only 11,130,875 of Canadian freight; 78.7 per cent of the tonnage therefore originated in the United States, most of this passing through the Sault Ste. Marie Canal.

The annual report of the Canadian Minister of Railways and Canals for 1913 says that the combined water and rail rate from Port Arthur—Fort William to Buffalo—New York was 8.796¢ per bushel of wheat against 6.341¢ per bushel over the Port Arthur—Ft. William to Montreal route. Notwithstanding this difference of 2.455¢ in favor of Montreal, ten times as much Canadian wheat went out by way of Buffalo—New York in November, as by Montreal, which is attributed to the greater availability of ocean tonnage and lower ocean freight and insurance

rates at New York. Of the 141,726,899 bushels of Canadian wheat from the northwest in 1913, 70,938,099 bushels came to Buffalo. Nearly all of this reached New York by rail or went to other ports, as the total receipts of wheat and flour (of all kinds) at New York by canal in 1913 were only 4,371,700.

Canadian competition is rendered more effective, because the Canadian Pacific gathers the grain, delivers it to lake and canal, and Canadian Pacific steamers take it at Montreal and Quebec and deliver the same abroad.

All concede the advantage of through rail lines in moving freight. The present New York Central line from Albany and Troy to Buffalo consisted, at one time, of twelve separate corporations. Our laws recognize the right of continuous lines of railroad to consolidate, while forbidding parallel or competing lines to consolidate. It is just as much for the interest of commerce that roads, terminating at the seaboard, be continued by steamship connections. The Canadian Pacific Railway, with its line of steamships in both the Atlantic and Pacific, connecting with its respective termini, and reaching Europe

and the Orient, enjoys superior advantages in the general competition for traffic, an advantage that enures of course to the benefit of the Canadian people. Contrast this policy with the absurd law passed by our government, forbidding any railway-owned vessel to pass through the Panama Canal.

THE WATERWAYS QUESTION AND CON- SERVATION OF OUR RESOURCES

THE rehabilitation of both the artificial and the natural waterways in the United States has been brought prominently forward for *national* consideration by reason of the inability of the land routes to give adequate service at periods of special pressure. In the Fall of 1906 both our cotton and our grain crops were several weeks late in reaching market for lack of transportation facilities. The delay was caused not so much by want of rolling stock, as by insufficient roadbeds and terminals. As population increased, factories, warehouses, docks, and all the structures designed to house and expedite commerce, were builded about the railways and their depots, until now they are wedged in as by a vise. They periodically lack trackage and terminals sufficient to enable them to do the business which offers. The space they need to enable them to double, treble, or quadruple track their roads and en-

large their terminals, can only be obtained at almost prohibitive prices, and in many cases is unattainable. In 1914, with all commerce with Europe temporarily stopped by the war that comprehended all the principal European nations, the terminals of the railways and terminal warehouses were speedily congested. As population becomes still more dense and our civilization more complex, our production and commerce expanding, these essential conditions of land transport will become more difficult; the water routes will unavoidably be resorted to for the solution of the problems thus presented.

History shows that enterprise, in its various forms, moves in waves, with maximum and minimum growth and periods of stagnation or comparative inactivity. In the development of a new country, under the impulse to anticipate the future, to realize presently the greatest possible profit, it was but natural that the rapid transportation of the railway would monopolize the public interest, and canal transportation be voted too slow. Small wonder that canal construction should be neglected, under the circumstances, and even existing canals be per-

mitted to fall into disuse and be abandoned. With denser population and overtaxed transportation facilities, the tide has turned; the public, confronted by conditions, not theories, realize that rail transportation must be supplemented and complemented by inland water routes. Other nations have far surpassed us in these respects, and we are bound to follow in the wake of this world-wide influence. There are powerful factors at work in favor of the canalization of our rivers and lakes. A national movement for the conservation of our natural resources has been inaugurated by Congress. The President convened the Governors of all the States to meet other distinguished men, to consider the same question. The scope of this policy can best be stated in the words of Senator Newlands: *

“A comprehensive plan for the development of our waterways of necessity takes into consideration all of the related questions of forest preservation and restoration, of the irrigation of arid lands, of the reclamation of swamp lands, of bank protection, of clarification of streams and other kindred subjects, as well as canal construction. It does not mean simply getting a dredging machine for the purpose of removing sandbars and

* North American Review.

digging a channel. It involves the prevention of floods, when the rivers rush down in torrential streams, destroying property, and then, having wasted the water in the ocean, are attenuated until boats cannot float upon them. It involves the preservation of forests, because forests are the great conservators of moisture and aid in the gradual distribution to the rivers. It involves the question of irrigation of arid lands at the head waters of our inland rivers—the creation of great reservoirs, where the flood waters can be impounded and led over the plains for purposes of irrigation, to be gradually returned to the rivers when most required by them. Where it cannot be advantageous to irrigation, the water can be kept impounded—as is now done in the upper Mississippi and in some foreign countries—to be let out at a time of low water in such a manner as to maintain navigation throughout the summer.

Forestry and irrigation are both essential to the prevention of floods and soil waste and to the maintenance of a stable channel for navigation, besides creating vast money values and great happiness and comfort in the development of immense forests and broad plains irrigated to almost unlimited productiveness. The artificializing of a river means that it shall be kept at a standard depth, to accommodate vessels of standard draught, just as there is a standard gauge for railroads. . . .

It also involves the reclamation of swamp lands, which means the addition of large and immensely fertile areas to the productive resources of the country. *The reclamation of swamp lands as such is not one of the powers of government granted by the constitution, but the control of the river for purposes of navigation is, and for this purpose*

the redemption of vast swamps, along the lower reaches of the rivers, is as much a function of the government as the irrigation of arid and semi-arid wastes at the source of the rivers. The channels fill up because where there are broad stretches of lowland, over which the river spreads, in high water, the river channel is lost in a network of bayous and swamps. When confined in comparatively narrow channels, by means of levees, the current is restrained and quickened and becomes an effective power in scouring instead of clogging the bottom, and in preserving the channel; so that we have inseparably connected with the question of navigation, the redemption of swamp lands and bank protection."

The government, through its power to regulate interstate commerce, will make canalization incidentally cover irrigation, forest-preservation, drainage, clarification, bank-preservation. With an open Treasury little difficulty will be encountered from strict constructionists of the Constitution; the reserved rights of the States will hardly assert themselves to prevent expenditure of money which must enure largely to their local benefit. An abstract proposition, infringing State sovereignty, would be resisted, but a concrete project, flavored with Treasury notes, will pass unchallenged.

Mark the evolution of constitutional construc-

tion; mark also the return of the canal to popular favor. Deep-water navigation from St. Louis to the Gulf commands the approval of railway managers, as well as publicists, and is knocking at the Treasury door with inviting countenance from within.

The Panama Canal has just been completed at a cost surpassing any other public work, and largely for altruistic motives, since the whole world is given its use upon precisely the same terms as are enjoyed by the United States. Such powerful examples must exercise a contagious local influence throughout the country.

DEPARTMENT OF INTERNAL NAVIGATION

UNDER the Secretary of Commerce there should be a Department, charged with the duty of studying our harbors and rivers, determining what ones are worthy of government aid, ascertaining the nature and extent of desired improvement, and specifically recommending what work should be done in order that same may be done systematically, economically and efficiently. The importance of this work is well expressed by the annual cost to the taxpayers of the country.

Appropriations for Rivers and Harbors are as follows:

1907	\$17,254,050
1908	43,310,813
1909	18,092,945
1910	29,190,264
1911	49,380,541
1912	30,883,419
1913	40,559,620
1914	<u>51,118,889</u>
Total eight years.	\$279,790,541
From 1802 to 1890	214,039,886
From 1891 to 1906	<u>301,447,546</u>
Total since 1802	\$795,277,973

No better use can be made of public funds, than their wise expenditure in the interest of transportation; it is, however, common knowledge that ambitious Congressmen secure appropriations, to be expended in their districts, for the ostensible purpose of improving inland navigation, upon most inconsequential streams, where purely local and selfish interests are served and the alleged public interest is used merely as a leverage to secure the funds. Even in the case of important streams, government funds are often unwisely expended. To illustrate this, I quote from a minority report upon the River and Harbor Appropriation Bill, made by Senator Burton, of Ohio, June 25, 1914:

<i>River</i>	<i>Tonnage last year</i>	<i>Value of tonnage</i>	<i>Appropriations to date</i>	<i>Appropriation in 1914 bill</i>	<i>Cost of commerce per ton</i>
"Arkansas	71,516 ¹	\$1,170,990	\$3,108,008.44	\$164,700	\$4.04 ⁴
Petaluma Creek, Cal.	231,725	12,719,747	144,898.00	7,500	.06
Red River, below Fulton, Ark.	44,967 ²	354,715	2,768,377.00	100,000	4.68
Cohansey River, N. J.	186,960	3,759,924	101,300.00	Nothing	.02
Missouri River, Kansas City to mouth . . .	185,110 ³	3,149,870	11,627,935.47	2,000,000	13.31
Bayou Teche, La.	613,367	6,269,404	441,500.00	130,000	.24

¹ The average haul was 34 miles. Of this tonnage 56,208 consisted of sawlogs.

² Of this tonnage 42,640 tons consisted of sawlogs carried an average distance of 131 miles.

³ Of this tonnage 155,420 tons consisted of sand and gravel barged a distance of 1 mile.

⁴ Derived by taking 4 per cent of total appropriations to date, plus appropriations in 1914, and dividing by the tonnage.

It is perfectly manifest that the further improvement, at least on any large scale, of certain large streams in which there is open-channel navigation, is futile, although in previous years, and especially before the more recent development of railways, these waterways were utilized to a very considerable extent.

There should be a careful re-examination of each of these waterways and a policy adopted which squares with present conditions. The following are illustrations: On the Red River below Fulton, covering a distance of

475.4 miles, there was in the year 1912 a total tonnage of 44,967 tons. Of this amount 42,640 tons were sawlogs, of which the average haul was 131 miles, and lumber 1,100 tons. Of the balance of the freight, including lumber, amounting to 2,327 tons, part was carried 45 and part 80 miles. The total amount appropriated to date for this stream is \$2,768,377. There was no appropriation in the pending bill as it came from the House, but by a proposed Senate amendment \$100,000 has been inserted. The expense per ton to the United States government for carrying this freight, including the lumber, can be approximately obtained if an allowance of 4 per cent is made on the amount appropriated to date and the prospective appropriation in the pending bill is added. This interest on the investment would amount to \$110,735.08, and adding the \$100,000 appropriated, would make a total of \$210,735.08. The cost per ton would be \$4.68, or if the sawlogs are excluded, the cost per ton would be \$90.56, and the cost per ton-mile \$1.53. As against this figure per ton-mile, the average charge per ton-mile on freight carried on the railroads of the United States in the year 1911 was \$0.00757. An improvement under such circumstances does not fall short of absurdity.

On the Arkansas River the total tonnage was 71,516 tons, of which 56,208 tons were sawlogs. The balance, 15,308 tons, notwithstanding the length of the so-called navigable portion of the river, (463 miles) was carried an average of only 34 miles. The appropriations to date on this stream have been \$3,108,008.44, and the appropriation in the pending bill is \$164,700. Using the same computations as before, of 4 per cent on the amount appropriated for this river, and the \$164,700 appropriated

in this year, which includes work at Pine Bluff and the completion and operation of a dredging plant, the cost for carrying each ton would be \$4.04. If the sawlogs are excluded, the cost per ton would be \$18.81. And yet it is proposed to expend on this stream \$349,000 for permanent plant and \$118,000 per year for its maintenance.

On the Missouri River from the mouth to Kansas City the total tonnage in 1912 was 185,110 tons, of which sand and gravel hauled 1 mile made up 155,420 tons, leaving a balance of 29,690 tons of other freight. The only long-distance traffic, which was carried 339 miles, according to the reports and designated as "miscellaneous freight" was 4,173 tons, to which must be added manufactured iron and steel products, carried 158 miles, 1,404 tons. It should be said that the reports not yet officially made are to the effect that this traffic has increased in the year 1913, and also shows a somewhat greater increase, amounting to about 3,000 tons per month, between the mouth of the river and Kansas City for the year 1914; but taking the latest official statistics as a basis, it appears that there has been appropriated for this stream between the mouth and Kansas City under old projects, \$7,227,935, and under the existing project, which calls eventually for \$20,000,000, \$4,400,000, making the total appropriation \$11,627,935. It is estimated that the maintenance of navigation on this river, after the expenditure of \$20,000,000, in addition to amounts appropriated prior to 1910, will cost \$500,000 per year. Capitalizing the expenditure already made on this river at 4 per cent plus the appropriation proposed, the cost per ton after excluding sand and gravel carried 1 mile, would be \$88.08."

With reference to the canalized Kentucky River, the report of the Chief of Engineers for 1909, volume 1, page 642, says:

“The principal commerce of the river is timber, much of it loose logs, and the improvement is rather detrimental to this than otherwise. The logs are damaged in passing the dams, and in their turn cause much damage to the works and are a prolific source of snags and other discouragement to any steamboat traffic that might develop.”

The above quotations will serve to illustrate the unsystematic, unscientific and wasteful method which now obtains in attempting to improve inland navigation by the United States government. The harbors that dot the very long line of our seacoast, are the open doors that welcome commerce from abroad, and through which our own products seek other countries; they should be improved and kept in good state of efficiency. The improvement of the estuaries and rivers extending from these harbors inland, in fact all interstate rivers and lakes, is a proper charge upon the United States Treasury.

Senator Burton, speaking with special reference to the River and Harbor Bill, summarizes the reforms that should be made, as follows:

“ 1. Provision for the completion of an improvement in the bill in which it is adopted.

2. A careful review of pending projects in the light of present conditions and the omission of all improvements which are no longer profitable.

3. A more careful consideration before the adoption of projects. There should be especial care to avoid lock and dam construction save in streams which are capable of being made important arteries of commerce.

4. A division of expense when exceptional advantages accrue to private property or specific localities, or when the protection of private property is the main object and navigation subordinate.

5. The exclusion from the bill of proposed improvements which do not have to do with navigation.

6. A general policy of improving the main stream before attention is given to branch streams, and the adjustment of depths and dimensions with a view to a uniform and comprehensive plan for the development of such waterways as can profitably be utilized.

7. Such adjustment of the relations between railways and waterways as will secure the utilization of routes partly by land and partly by water when coöperation and utilization of both routes can be made profitable as a means of transportation.

8. Before expenditures are incurred, make certain that sufficient terminal facilities for traffic will be afforded; also that no monopoly or undue advantage by any individual or corporation as a result of any improvement made.”

If this whole subject were placed under a Department of Internal Navigation or a Com-

mission, perhaps, would not the public interest be conserved and the public purse be better protected? Would not order succeed confusion, efficiency succeed waste, and expenditure find expression in good practical results?

The successful development and solution of the transportation problem in our country, as in other countries, depends upon the coördination and coöperation of our railways and our water routes, be they canals, canalized lakes and rivers, or natural bodies of water, such as the Great Lakes and the high seas. *These two systems of transportation must supplement and complement each other.*

APPENDIX

Table 1 gives year opened, length, prism, locks, cost and termini of all principal canals of the United States.

Table 2 presents data as to the canals of New York now in use, canalized rivers and lakes, and other important facts.

Table 3 presents the number, mileage, traffic and ownership of canals and canalized rivers in the United States, in 1906.

Table 4 shows the number and length of navigable rivers in the United States, an analysis of their traffic and the appropriations made in support of same, by Congress.

Table 5 gives the revenues and cost of New York canals from inception until tolls were abolished in 1882.

Table 6 is a statistical exhibit of the competition between railways and canals, from 1853 to 1912.

Table 7 compares the Buffalo receipts and shipments of grain and flour, by canal and rail.

Table 8 compares the receipts of grain and flour at New York, 1909-1913, by canal, coastwise and rail.

Table 9 is a statement of traffic on all canals, 1904-1913.

Table 10 is a statement of the value of the traffic on all the canals, 1904-1913.

Table 11 gives the kinds and classification of all freight on New York canals, 1903-1912.

Table 12 shows the annual average freight rates, Chicago to Liverpool, all rail and all water, 1893-1913.

Table 13. New York, Ohio, Indiana, Illinois and Michigan are the States that have benefited, in greatest degree, from the Erie Canal, and in order to show its favorable influence these States are compared with all other States in the Union in this Table, in respect to wealth and population.

Table 14 gives various statistics as to the City of New York, which is unquestionably the principal beneficiary under the New York State canal system.

Table 15 compares New York with other great ports of the world.

Table 16 gives the miles saved by using the Panama route, as compared with other routes.

	Opened year	Length miles	Bottom width feet	Depth feet	Locks No.	Cost	Points connected
Albemarle & Chesapeake (Va.) ..	1860	14	45	10	1	\$1,151,849	Chesapeake Bay—Albemarle Sound
Augusta (Ga.) (ship) ..	1847	7	106	11	1	2,000,263	Augusta—Savannah River
Beaufort (N. C.) ..	1882	5		5		35,000	Clubfoot and Harlow Creeks
Black River (N. Y.) ..	1849	42	28	4	101	3,004,000	Rome—Lyons Falls
Cayuga & Seneca (N. Y.) ..	1839	21	56	7	11	2,332,652	Montezuma—Geneva
Champlain (N. Y.) ..	1822	66	35	5	20	—	Whitehall—Albany
Chesapeake & Delaware (Del.) ..	1829	13	40	10	3	5,000,000	Delaware River—Chesapeake Bay
Chesapeake & Ohio (Md.) ..	1850	181	31	6	75	14,000,000	Washington—Cumberland
Chicago Drainage (Ill.) ..	1900	28	158	22	1	52,697,495	Chicago—Lockport
Columbia (Oregon) ..	1889	4.5		8	2	3,816,394	Around the Cascades
Company's (La.) (Ship) ..	1847	95	45	5.5	1	500,000	Mississippi River at New Orleans—La-
Delaware & Raritan (N. J.) ..	1838	44	40	9	13	5,113,749	New Brunswick—Bordentown
Des Moines Rapids (Ia.) ..	1877	7.6		5	3	4,666,889	Keokus—Nashville and Nashville-
Erie (N. Y.) ..	1825	352	56	7	72	† 65,402,033	Albany—Buffalo
Fairfield (N. C.) (Ship) ..	1868	4	26	7	—	60,000	Fairfield and Alligator River
Galveston & Brazos (Texas) ..	1853	20	37	30	—	369,698	Oyster Bay—Brazos River
Illinois & Michigan (Ill.) ..	1848	96	30	8	18	9,194,498	Chicago—LaSalle
Lake Drummond (Va. & N. C.) ..	1794	22	40	9	2	3,301,000	Elizabeth River (Va.)—Pasquotank
Lake Superior (Mich.) ..	1873	7.7		20	—	4,246,728	L. Superior—Portage L., Keweenaw Bay
Lehigh Coal (Pa.) ..	1821	96	18	6	91	7,566,450	Coalport—Easton—Bristol
Louisville & Portland (Ky.) ..	1830	2.4		12	2	5,856,230	Around falls of Ohio River at Louisville
Miami & Erie (O.) ..	1835	263	35	5	95	8,662,680	Toledo—Cincinnati
Morris (N. J.) ..	1836	106	30	5	95	6,000,000	Jersey City—Easton, Pa.
Ohio (O.) ..	1835	326	26	4	144	7,004,971	Cleveland—Portsmouth
Oswego (N. Y.) ..	1828	38	56	7	18	5,161,793	Oswego—Syracuse
St. Mary's Falls (Mich.) ..	1855	1.6		25	2	8,000,000	Around the falls of St. Mary's River
Schuylkill Navigation (Pa.) ..	1826	50	40	6	55	11,018,875	Philadelphia—Port Clinton

* With Feeder.

† Including the Champlain.

II. DATA AS TO THE CANALS OF NEW YORK NOW IN USE, CANALIZED
RIVERS AND LAKES, AND OTHER IMPORTANT FACTS

CANALS OF NEW YORK STATE

	<i>Length Miles</i>	<i>Depth Feet</i>	<i>Locks No.</i>	<i>Maximum burden of boats</i>
Erie.....	351.7	7.0	72	240
Oswego.....	38.0	7.0	18	240
Cayuga and Seneca.....	23.0	7.0	11	240
Champlain.....	66.0	5.0	20	120
Glens Falls Feeder.....	12.0	5.0	12	85
Pond above Troy Dam.....	3.0	—	1	—
Black River.....	42.0	4.0	101	76
Oneida River Improvement....	20.0	4.5	2	76
Oneida Lake.....	70.0	7.0	7	220
Baldwinsville & Seneca Towpath	5.7	4.0	1	76

The Erie Canal was authorized April 15, 1817 and work begun the same year. It was completed October 26, 1825 at a cost of \$7,143,789. It was enlarged in 1836-1862 at a cost of \$44,465,414. Canals in New York are owned and maintained by the State free of tolls.

The total debt of the State of New York on September 30, 1913 was \$135,478,192 of which \$90,000,660 was on account of the State canals. The canal debt was 66 per cent of the total debt. From 1817 to 1882 (when tolls were abolished) the gross revenues of the Erie Canal were however \$121,461,871 which gave a profit to the State over cost of construction and operation of \$42,599,718. •

During its Canal history, the State has opened 1050

miles of navigable waterways including 100 miles of interior lake navigation. In addition there are 500 miles of lake and river navigation and the Hudson River is navigable for 150 miles. Of the canals 350 miles have been abandoned and 50 miles more have fallen into disuse. Traffic on the Erie Canal has been steadily declining, but the great work of canal enlargement now in progress, known as the Barge Canal improvement, will, it is expected, result in a notable expansion in transportation.

III. NUMBER, MILEAGE, TRAFFIC, AND OWNERSHIP OF CANALS AND CANALIZED RIVERS IN THE UNITED STATES, IN 1906

	<i>No.</i>	<i>Mileage</i>	<i>Cost</i>	<i>Freight carried, tons</i>
Government owned canals.....	12	78.19	\$26,524,588	96,729,333
State and Corporation owned canals.....	29	2,046.01	213,797,297	6,606,814
Canalized rivers.....	23	1,520.40	42,886,978	19,098,258
Total.....	64	3,644.60	283,208,863	122,434,405

Notes: (a) Up to 1906, there had been 2,841 miles of canals and canalized rivers abandoned in the United States. These had cost \$73,168,795.

(b) Over 75 per cent of the freight carried was that passing through the Sault Ste Marie canals and the Canal at the flats adjacent to Lake St. Clair. Only 4,320,138 tons were carried on other canals than the ship canals.

(c) No tolls are charged on Federal or on New York canals.

(d) These statistics were gathered by the Bureau of the Census in 1906. The next canal census will be taken in 1916.

(e) The freight traffic on the railroads of the United States in 1906 amounted to 1,631,374,219 tons. In 1912 the amount was 1,844,977,673.

(f) Canal Projects. The two most extensive schemes now proposed are (1) the Lakes-to-the-Gulf waterway which includes the Mississippi

improvement, the canalization of the Illinois River, and the Chicago Drainage Canal;

(2) A series of canals along the Atlantic seaboard that would give interior waterway communication from Massachusetts to the Carolinas, utilizing the newly constructed Cape Cod Canal, and enlarging the Delaware and Raritan Canal, and the Delaware and Chesapeake cut.

(g) The largest river canalization project now in progress is that in the Ohio River from Pittsburg to Cairo, making a low water depth of nine feet. Construction of 54 dams and locks is necessary.

IV. THE NUMBER AND LENGTH OF NAVIGABLE RIVERS IN THE UNITED STATES, AN ANALYSIS OF THEIR TRAFFIC AND THE APPROPRIATIONS MADE IN SUPPORT OF SAME, BY CONGRESS

There are 295 rivers in the United States having a navigable length of 26,410 miles.

The following is an analysis of the traffic on the more important of these streams (those having a traffic of more than 1,000,000 tons a year) made by Senator Burton of Ohio in a report to the United States Senate June 25, 1914. The figures in most instances are for the year 1912, the amounts appropriated by Congress include all to date for the specified waterways.

1—Rivers and creeks in whole or in part utilized as harbors.

<i>River</i>	<i>Tonnage</i>	<i>Amount appropriated</i>	<i>Navigable length</i>
Hudson, between New York City and New Jersey	72,000,000	\$225,000	<i>Miles</i> 8
East, between New York City and Brooklyn	45,331,216	6,233,341	15
Harlem, in and near New York City . .	15,376,742	1,943,000	8
Providence, to Providence, R. I.	4,585,364	2,766,489	7
Newtown Creek, between Brooklyn and Queens County	4,921,843	510,000	4
Mystic, below Island End River in Boston	3,671,242	283,005	1.5
Rouge, at the southerly limits of Detroit	1,321,098	106,690	4.5
Snohomish, Wash.	1,096,731	280,000	3.2

2—Rivers connecting large cities with the sea:

<i>River</i>	<i>Tonnage</i>	<i>Amount appropriated</i>	<i>Navigable length</i>	<i>Depth</i>
			<i>Miles</i>	<i>Feet</i>
Delaware to Philadelphia . .	26,267,335	\$19,189,000	101	30.1
Patapsco to Baltimore	10,029,875	8,616,280	20	35
Mississippi to New Orleans .	4,279,947	10,357,288	114	30
Savannah to Savannah . . .	3,120,676	10,456,747	17	23.5
Passaic to Newark and Passaic	2,266,291	1,950,350	16	6-16
St. Johns to Jacksonville . . .	2,204,794	6,060,089	27.5	24
Cape Fear to Wilmington, N. C.	1,072,205	5,881,168	30	26
Potomac to Alexandria and Washington	817,508	3,534,500	113	24
Pawtucket to Pawtucket, R. I.	622,166	506,584	4.5	16-25
James to Richmond	507,023	3,200,000	103.8	17.5

3—Rivers (tidal) but of less capacity:

<i>River</i>	<i>Tonnage</i>	<i>Amount appro- priated</i>	<i>Navi- gable length</i>	<i>Depth</i>
Raritan to New Brunswick, N. J.	1,177,157	\$746,528	<i>Miles</i> 12	<i>Feet</i> 10
Hackensack to Milford.	924,323	100,000	20.2	5-12
Connecticut to Hartford ...	617,981	873,170	50	10
Thames to Norwich.	565,480	551,600	15	14
Penobscot to Bangor.	549,476	506,300	27	11
Napa, Cal.	211,060	61,973	16	4
Maurice, N. J.	391,346	118,000	4	5
Wicomico, Md.	366,228	130,516	23	9
Cooper, N. J.	391,346	65,000	9	5
Bronx, New York City	319,083	226,500	3	3
Kennebec to Augusta.	281,700	897,945	44	10
Brazos to Velasco.	123,750	721,250	5	4
Merrimac to Haverhill.	86,651	405,366	17.5	7
Housatonic to Derby.	86,009	327,450	13	6

4—Rivers used for traffic between inland points:

<i>River</i>	<i>Tonnage</i>	<i>Amount ap- propriated</i>	<i>Navi- gable length</i>	<i>Depth</i>
			<i>Miles</i>	<i>Feet</i>
Monongahela.....	11,575,329	\$10,229,689	87.5	6-9
Ohio.....	8,618,369	29,229,225	1,000	(1)
Hudson from Waterford to New York Harbor	3,045,136	8,566,524	156	12
Allegheny.....	2,632,789	2,284,459	61	8
Delaware from Philadel- phia to Trenton.....	1,547,787	551,000	30	2 7
Kanawha	1,319,154	4,295,863	90	6
Mississippi ³ between—				
New Orleans and Vicks- burg.....	1,807,740	78,409,555	885	9
Vicksburg and Memphis	1,394,789			
Memphis and Cairo ...	1,425,922			
Missouri River and St. Paul.....	1,830,294	18,607,622	558	⁴ 4.5

¹ Project, 9 feet.² Project, 12 feet.

³ The official statistics for the Mississippi River below Cairo are given in this form dividing the river into three sections. Through traffic passing through two or more sections is included in each and the sum of the traffic through all sections would involve a considerable duplication.

⁴ Project, 6 feet.

RECAPITULATION OF APPROPRIATIONS AND TRAFFIC

	<i>Appropriations</i>	<i>Traffic (tons)</i>
Class 1.....	\$ 12,347,525	148,304,236
Class 2.....	69,752,006	51,187,820
Class 3.....	5,731,598	6,091,590
Class 4.....	152,173,937	35,197,309
	<u>\$240,005,066</u>	<u>240,780,955</u>

V. REVENUES AND COST OF NEW YORK CANALS FROM INCEPTION UNTIL TOLLS WERE ABOLISHED IN 1882

<i>Canals, etc.</i>	<i>Gross revenues</i>	<i>Operation and maintenance cost</i>	<i>Result Gain +; Loss —</i>	<i>Cost of construction and improvement</i>	<i>Balances</i>
Erie.....	\$121,461,871	\$29,270,301	+\$92,191,570	\$49,591,853	Profit, \$42,599,718
Champlain.....	6,416,341	5,630,024	+	4,913,296	Loss, 4,126,978
Oswego.....	3,708,548	3,371,446	+	4,295,373	" 3,958,271
Cayuga and Seneca.....	1,054,356	1,027,539	+	1,834,184	" 1,807,367
Black River.....	301,100	1,552,230	—	3,894,952	" 5,146,083
Oneida Lake.....	65,894	144,060	—	511,649	" 589,816
Crooked Lake.....	45,490	424,658	—	395,091	" 774,260
Chemung.....	525,565	2,022,259	—	1,463,586	" 2,960,280
Chenango.....	744,027	2,081,739	—	4,789,471	" 6,127,181
Genesee Valley.....	860,165	2,814,809	—	6,737,430	" 8,692,074
Lesser works.....	234,968	60,222	+	258,695	" 83,948
Totals.....	\$135,418,325	\$48,399,287	+\$87,019,038	\$78,685,580	Net Profit, \$8,333,458

Ratio of Operation and Maintenance to Revenues: All — 35 $\frac{3}{4}$ %; Erie — 24%.

VI. STATISTICAL EXHIBIT OF COMPETITION BETWEEN NEW YORK
CENTRAL AND ERIE RAILWAYS AND CANALS, FROM 1853 TO
1912

<i>Five year Periods</i>	<i>Two Railways</i>	<i>Canals</i>	<i>Per cent by Canals</i>
1853-57	7.7	19.9	72.1
1858-62	12.5	22.2	64.0
1863-67	23.2	22.6	53.4
1868-72	42.3	31.6	42.7
1873-77	61.8	26.1	26.0
1878-82	95.5	27.6	18.8
1883-87	142.3	26.2	12.8
1888-92	201.6	24.4	8.7
1893-97	210.0	19.0	6.5
1898-02	289.1	17.1	5.6

Years

1903	68.6	3.6	5.0
1904	65.3	3.1	4.5
1905	70.5	3.2	4.3
1906	78.6	3.5	4.2
1907	84.1	3.4	3.9
1908	74.8	3.0	3.9
1909	72.8	3.1	4.0
1910	84.2	3.0	3.5
1911	83.0	3.0	3.5
1912	84.1	2.6	3.0

VII. BUFFALO RECEIPTS AND SHIPMENTS OF GRAIN AND FLOUR, BY
CANAL AND RAIL, COMPARED

	<i>Grain rec'd</i>	<i>Million bushels shipped by canal</i>	<i>Per cent by canal</i>	<i>Flour rec'd</i>	<i>Million bushels shipped by canal</i>	<i>Per cent by canal</i>
1868-72.....	238	185	77.7	6.6	2.3	34.8
1873-77.....	30	201	66.7	6.2	0.8	12.9
1878-82.....	366	246	67.2	5.3	0.4	7.5
1883-87.....	319	206	64.5	16.1	0.3	1.8
1888-92.....	515	185	35.9	33.8	0.2	0.6
1893-97.....	707	179	25.3	52.7	0.2	0.4
1898-02.....	747	94	12.5	53.0	0.1	0.2
1903-07.....	636	82	12.9	47.7	...	....
1908-12.....	611	66	10.9	37.5	...	....

GRAIN

	<i>Receipts bushels</i>	<i>Shipments bushels by canal</i>
1913.....	192,445,440	9,429,064
1912.....	159,793,348	6,405,158
1911.....	121,892,466	11,966,158
1910.....	102,071,175	17,584,651
1909.....	113,415,385	16,407,268
1908.....	114,245,438	14,314,159

Note: During these six years 47,066,644 barrels of flour were received at Buffalo, but none was shipped by canal.

VIII. RECEIPTS OF GRAIN AND FLOUR AT NEW YORK, 1909-1913,
BY CANAL, COASTWISE AND RAIL, COMPARED

	<i>Canal</i>	<i>Per cent</i>	<i>Coast- wise</i>	<i>Rail</i>	<i>Total</i>
1913.....	4,371,700	3.1	3,904,292	131,768,203	140,044,195
1912.....	3,530,600	2.7	4,268,675	122,371,905	130,171,180
1911.....	7,895,000	6.6	3,913,254	107,411,728	119,219,982
1910.....	11,000,700	11.3	441,588	86,635,278	98,077,566
1909.....	9,676,000	10.2	1,863,504	82,895,110	94,434,614

IX. STATEMENT OF TRAFFIC (TONS) ON ALL THE CANALS, 1904-1913
ARRIVING AT TIDE WATER

YEARS	Via Erie Canal			Via Champlain Canal		Total arriving at tide water	Internal movement of New York State	Total movement
	From western states	From New York State	From Vermont and Canada	From New York State				
1904.....	664,616	287,000	64,365	182,724	938,691	1,535,240	3,138,547	
1905.....	638,865	328,652	47,065	259,933	1,070,343	1,517,688	3,226,896	
1906.....	606,029	272,360	131,070	174,862	1,071,072	1,862,906	3,540,907	
1907.....	587,836	420,937	114,237	76,054	869,621	1,950,757	3,497,914	
1908.....	552,821	332,587	64,141	118,779	855,920	1,643,136	3,051,877	
1909.....	565,493	339,545	102,479	132,100	794,007	1,757,036	3,116,536	
1910.....	657,175	359,247	119,844	100,807	761,260	1,954,977	3,073,412	
1911.....	507,063	259,834	103,481	83,683	658,256	1,931,749	3,097,068	
1912.....	420,819	184,030	143,452	74,481	518,616	1,966,681	2,666,116	
1913.....	392,654	186,216	102,974	121,592	499,359	1,710,022	2,602,035	

X. STATEMENT OF VALUE OF TRAFFIC ON ALL THE CANALS, 1904-1913

YEARS	Erie Canal	Champlain Canal	Oswego Canal	Cayuga and Seneca Canal	Black River Canal	Total
1904	\$52,601,795	\$9,403,884	\$3,054,946	\$741,660	\$579,532	\$66,381,817
1905	43,343,925	9,341,863	3,456,009	1,134,888	641,801	57,918,586
1906	51,547,038	9,417,727	3,010,189	2,023,465	502,998	66,501,417
1907	49,597,650	8,994,236	2,889,106	1,919,878	503,100	63,903,970
1908	43,805,959	7,239,843	1,726,131	1,117,282	622,294	54,511,509
1909	45,686,265	8,405,842	2,461,687	1,054,189	1,413,389	59,081,572
1910	44,972,403	9,061,652	2,144,936	1,166,542	1,690,645	59,042,178
1911	36,993,695	8,506,820	2,317,567	983,368	776,179	49,577,629
1912	27,944,535	6,976,391	1,840,736	1,334,722	348,133	38,444,617
1913	27,459,891	6,646,280	1,055,366	1,357,942	345,972	36,865,451

XI. KINDS AND CLASSIFICATION OF ALL FREIGHT ON NEW YORK
CANALS, 1903-1912

	<i>Forest</i>	<i>Products of agri- culture</i>	<i>Manu- facture</i>	<i>Mer- chandise</i>	<i>Other</i>	<i>Total</i>
1912	584,964	196,014	119,512	152,982	1,552,644	2,606,116
1911	656,500	355,301	137,463	166,419	1,781,385	3,097,068
1910	654,094	492,536	145,419	215,446	1,565,917	3,073,412
1909	647,739	447,217	163,871	194,273	1,663,436	3,116,536
1908	565,443	449,846	106,371	166,061	1,764,156	3,051,877
1907	747,736	606,159	96,916	169,258	1,787,845	3,407,914
1906	854,610	648,715	170,584	202,285	1,664,713	3,540,907
1905	851,098	436,979	132,438	172,665	1,633,716	3,226,896
1904	738,793	427,969	129,665	200,472	1,641,648	3,138,547
1903	690,161	595,047	130,406	241,564	1,956,207	3,615,385

XII. ANNUAL AVERAGE FREIGHT RATES, CHICAGO TO LIVERPOOL,
ALL RAIL AND ALL WATER, 1893-1913

PER BUSHEL OF WHEAT

CALENDAR YEAR	CHICAGO TO NEW YORK			N. Y. TO LIVER- POOL
	<i>By lake and canal</i>	<i>By lake and rail</i>	<i>By all rail</i>	
	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Pence</i>
1893.....	6.33	8.44	14.7	2 $\frac{3}{8}$
1894.....	4.44	7.00	12.88	1 $\frac{1}{16}$ $\frac{5}{8}$
1895.....	4.11	6.95	12.17	2 $\frac{1}{16}$ $\frac{9}{16}$
1896.....	5.38	7.32	12.0	2 $\frac{1}{16}$ $\frac{5}{8}$
1897.....	4.35	7.37	12.32	3 $\frac{1}{16}$
1898.....	4.42	4.96	11.55	3 $\frac{1}{16}$ $\frac{7}{16}$
1899.....	5.65	6.63	11.13	2 $\frac{1}{16}$ $\frac{7}{16}$
1900.....	4.42	5.05	* 9.98	3 $\frac{3}{8}$
1901.....	5.14	5.57	* 9.92	1 $\frac{1}{4}$
1902.....	5.25	5.78	* 10.60	1 $\frac{1}{16}$ $\frac{7}{16}$
1903.....	5.44	6.17	* 11.33	1 $\frac{1}{16}$ $\frac{7}{16}$
1904.....	4.71	5.02	* 11.11	1 $\frac{1}{8}$
1905.....	5.51	6.44	* 10.20	1 $\frac{5}{8}$
1906.....	5.94	6.48	* 10.50	1 $\frac{1}{16}$ $\frac{7}{16}$
1907.....	6.68	6.93	* 11.30	1 $\frac{3}{4}$
1908.....	6.00	6.33	* 11.70	1 $\frac{1}{16}$ $\frac{9}{16}$
1909.....	5.35	6.88	* 11.70	1 $\frac{5}{8}$
1910.....	5.13	6.57	* 9.60	1 $\frac{1}{2}$
1911.....	5.35	5.23	* 9.69	2
1912.....	5.57	6.17	* 9.60	3 $\frac{1}{16}$ $\frac{1}{16}$
1913.....	5.74	7.01	* 9.60	2 $\frac{1}{16}$ $\frac{9}{16}$

* For domestic consumption; local rate for export only 9.08 cents in 1900; 9.02 cents in 1901, and 8.75 cents in 1902; and, when consigned and delivered to steamer, 8.89 cents in 1903, 8.47 cents in 1904, 7.99 cents in 1905, 8.10 cents in 1906, 9.70 cents in 1907, 10.50 cents in 1908 and 1909, and 7.80 cents in 1910, 1911, 1912, and 1913.

XIV. VARIOUS STATISTICS AS TO THE CITY OF NEW YORK, WHICH
IS UNQUESTIONABLY THE PRINCIPAL BENEFICIARY UNDER THE
NEW YORK STATE CANAL SYSTEM

Over 47 per cent of the total foreign commerce of the United States in 1913 passed through the Port of New York, her share of the merchandise imports being 57.8 per cent, and of the exports 37.2 per cent.

Of the 335,000,000 bushels of grain (including flour) received at New York, Boston, Philadelphia, Baltimore, New Orleans and San Francisco in 1913, New York's share was 39.8 per cent, being 133,531,482 bushels.

New York's exports of flour in 1913 were 4,549,838 barrels, its largest competitor being Montreal with 1,760,653 barrels. In 1907 New York exported 3,002,455 barrels and Montreal 861,936 barrels.

New York's exports of wheat in 1913 were 49,019,674 bushels as compared with 27,111,717 in 1907. Montreal's exports were 33,706,089 bushels in 1913 against 20,949,496 in 1907.

Of the 41,015 vessels with a total tonnage of 50,639,173 engaged in the foreign trade that entered the ports of the United States in 1913, there were 4223 which entered the Port of New York, their tonnage being 14,464,161 or 28.4 per cent of the total for the whole country. These figures do not include the tonnage engaged in the domestic trade.

The bank clearings of New York in 1913 amounted to \$94,634,281,984 over 55 per cent of the total clearings of the United States. The five largest cities in the country next to New York have combined clearings considerably less than one-half those of this city whose

business as measured by bank transactions is greater than that of all the rest of the United States.

Over 14 per cent of all the loans and discounts of the National banks of the United States in 1913 were made by the National banks of New York.

The banking resources of the seven principal cities of the country in 1913 were \$9,033,023,786 of which \$4,460,360,980 were represented by the banks in New York. The banking resources of this city are 17 per cent of those of the United States. It ranks as one of the four great international money markets.

The census of 1910 showed that nearly 10 per cent of the manufacturing establishments of the United States and nearly 10 per cent of the value of their yearly products are located and produced in New York which contains more industries than Chicago, Philadelphia, St. Louis and Cleveland combined.

New York City contains about 5 per cent of the total population of the United States, and the last ten year percentage of increase was greater than that of the four next largest cities of the country. The Metropolitan district of New York (the city proper with near suburbs) is increasing at the rate of over 40 per cent in ten years while the Metropolitan district of London is increasing only 10 per cent, so that in a few years at most New York will be the largest city in the world.

New York's total ocean passenger traffic in 1913 amounted to 1,843,770.

The real and personal estate of the State of New York in 1913 had an assessed value of \$11,128,498,055; and that of the City of New York \$8,390,155,472.

XV. COMPARES NEW YORK WITH OTHER GREAT PORTS OF THE WORLD

	<i>International Commerce</i>	<i>Year</i>	<i>Vessel Tonnage Entered</i>	<i>Year</i>	<i>Popula- tion</i>	<i>Year</i>
New York	\$1,966,256,617	1913	14,464,161	1913	6,474,568 *	1910
London	1,866,930,782	1912	10,800,716	1912	7,252,963 *	1911
Hamburg	1,960,779,855	1912	13,567,913	1912	953,079	1912
Liverpool	1,816,983,279	1912	7,253,016	1912	746,421	1911
Antwerp	1,214,725,495	1912	11,483,214	1912	291,949	1905
Rotterdam . . . . .	.....	....	11,552,119	1912	370,390	1905
Marseilles	731,430,800	1912	8,051,321	1911	517,498	1906
Bremen	632,493,751	1912	1,688,891	1912	214,861	1905
Havre	619,245,100	1912	3,582,065	1911	130,196	1901
Buenos Aires	479,536,241	1912	.....	....	1,326,994	1911
Hull	391,005,790	1912	3,964,583	1912	277,991	1911
Copenhagen . . . . .	.....	....	3,135,006	1910	476,806	1901
Cherbourg . . . . .	.....	....	3,921,812	1911	42,938	....
Trieste	307,512,228	1912	2,059,964	1912	221,993	1909

* Metropolitan Districts.

XVI. GIVES THE MILES SAVED BY USING THE PANAMA ROUTE, AS
COMPARED WITH OTHER ROUTES

<i>New York to</i>	<i>Via Panama, etc. miles</i>	<i>Via Suez, etc. miles</i>	<i>Via Magel- lan, etc. miles</i>	<i>Via Good Hope miles</i>	<i>Saved through Panama miles</i>
San Francisco.....	5,262	...	13,135	...	7,873
Callao.....	3,363	...	9,613	...	6,250
Yokohama.....	9,798	13,566	...	...	3,768
Hong Kong.....	11,691	11,673	...	...	....
Manila.....	11,548	11,589	...	...	41
Adelaide.....	10,904	...	...	12,650	1,746
Melbourne.....	10,392	...	...	13,162	2,770
Wellington.....	8,851	...	11,344	14,441	* 5,590

Note (a) Vessels from New York to Australia now round the Cape of Good Hope the distance being the same as by the Suez Canal.

(b) To Yokohama the route by Panama is to San Francisco and the Great Circle; and by Suez to Columbo, Singapore, Hong Kong and Shanghai.

To Hong Kong the route by Panama is to San Francisco, Yokohama and Shanghai; and by Suez to Columbo and Singapore.

To Manila the route by Panama is to San Francisco and Yokohama; and by Suez to Columbo and Singapore.

* 2,493 miles saved compared with Magellan route.

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